50p

YOUR COMPUTER

AUGUST/SEPTEMBER 1981

Vol.1 No.2



Review: Vic-20

Chess games

Atom graphics

ZX-81 machine code

Tantel Prestel adaptor

Win a Vic-20

Make the most of your Sinclair ZX Computer...

Sinclair ZX software on cassette.

£3.95 per cassette.



The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with other programs to form a single-subject cassette.

Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

8K BASIC ROM

The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.



Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP – Volumes, temperatures – and their combinations.

How to order

Simply use the order form below, and either enclose a cheque or give us the number of your Access, Barclaycard or Trustcard account. Please allow 28 days for delivery. 14-day money-back option.

sinclair ZX SOFTWARE

Sinclair Research Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN. Tel: 0276 66104.

To: Sinclair Research, FREEPOST 7, Cambridge, CB2 1YY *Please print*

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	22	Cassette 2 – Junior Education	£3.95	
	23	Cassette 3 – Business and Household	£3.95	
	24	Cassette 4 – Games	£3.95	
	25	Cassette 5 – Junior Education	£3.95	
	17	*8K BASIC ROM for ZX80	£19.95	
	18	*16K RAM pack for ZX81 and ZX80	£49.95	
		*Post and packing (if applicable)	£2.95	
			Total £	

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YOUR COMPUTER

Cover photograph of the Vic-20 by Stephen Oliver.

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EDITORIAL

COMPUTERS MUST BE becoming very popular. Almost everyone has a nephew or a brother, a niece or a sister, who has just bought a computer or wants to buy a computer or, more commonly, sent off the money for a computer three months ago and still has not received it.

In a rare flush of enthusiasm, one might argue that this popularising of computers heralds the dawn of a new golden age. At other moments, as one opens the hundredth letter of the day detailing a new more sophisticated version of Hangman on the ZX-81 we think no — we will all become obsessed with petty improvements in game-writing techniques. What chance there is of any dramatic change being wreaked by computers seems set well into the next century.

One only has to look at what some teachers are planning to do with their new-found tools to find further room for such sombre thoughts. Improved computer-aided learning programs sound very grand, but the idea of the next generation of kids learning their multiplication tables, or the codes of another 1,000 organic chemicals is hardly inspiring.

Perhaps we should not be planning to write programs to teach children but let children teach themselves through writing programs. It could yet be that the greatest benefit from computers will be the breaking down of the accepted ideas about correct solutions. One of the first things one learns when problem solving with a computer is that there is no one way to write a program. Some solutions are more elegant than others, more efficiently programmed, but one's aim is always the best possible solution — not the only one.

Then there is the idea of debugging, a way of life rather than a technique. A little experience of programming will teach any child that teacher's explanation of why certain chemicals react in a certain way, or why Dickens or Donne wrote what they did is only the teacher's or the examiner's best guess, not the intrinsically correct answer. Has, the child should ask, the teacher's view been debugged?

Unfortunately, the Department of Education and many teachers seem to think that the way to bring computers to schools is to form committees to draft new computer science curricula. Let us hope that there is a little more emphasis on letting people loose on the keyboards. With a little luck and some guidance, that should be enough.

ADDRESS FINDER

It has been shown in your pages how characters can be Poked on to the screen of the ZX-80 by Poking a character code into the appropriate address. However, one criticism of the ZX-80 is that the display addresses do not remain in the same position in the RAM. The problem is often one of finding where these addresses are.

The size of the display file is determined by the number of characters in the display, plus one for each end of line. Hence a completely full screen contains (32×23)+22, or 758 addresses. The start of the display file can be tracked down in this manner: the first address is given by the result of

PEEK(16396) + PEEK(16397) *256 + 1,

and the last address of a full screen is at

PEEK(16396) + PEEK(16397) *256 + 759

The following shows, rather crudely, the operation. Remember that the routine should be carried out each time access to the display is required if the program contains variables which alter. Line 70 checks to make sure that the end-of-line addresses are not Poked. CS$(128)s are Poked at random on to a full display.

```
10 FOR A=1 TO 23
20 PRINT,,,,
30 NEXT A
40 INPUT A$
50 IF A$="STOP" THEN STOP
60 LET B=RND(758)
70 IF (B/33)*33=B THEN GOTO
   60
80 POKE PEEK(16396)+PEEK
   (16397)*256+B,128
90 GOTO 40
```

N W Willder,
Belper,
Derbyshire.

ZX-80 QUANDARY

Let me say how good the first issue is — just right for the first-time micro owner like me. Can you answer the question that 49,999 owners of the ZX-80 and I want to know?

Should we sell our ZX-80s for say £45 and with another £28 buy the new ZX-81? Or do we spend £23 on a new 8K ROM instead? The difference will be the ability to do animated graphics on a ZX-81 but not on a ZX-80 with 8K ROM. Does this really matter much? Will I, in any case, be able to create animated displays using Pause on my ZX-80 with a new ROM as Robin Norman says in *Learning Basic with your Sinclair ZX-80* in appendix 6?

It has crossed my mind that when anyone shows us how to beat the dreaded ZX-80 flicker or I spend £5 to find out, I will be happy with my old ZX-80 and its 16K RAM — at least until the printer is available.

Maybe someone will develop an inexpensive hardware modification to beat the flicker and drive the printer. I have a horrible fear that these Sinclair add-ons will continue to appear for ever. I had enough trouble persuading my wife how essential the 16K was.

Is the new ROM really drop-in? None of the chips on my machine looks as though it is about to drop-out. Looking forward to the second issue.

Robert Redfern,
Rochdale,
Lancashire.

■ **It is hard to help you since, although the ZX-81 is certainly more powerful, many people, including our reviewer, still prefer the ZX-80. My own view is that if you find the ZX-80 interesting, it is time to start saving for a bigger and more expandable computer.**

Tim Hartnell

GAMES SOFTWARE

Congratulations on the new magazine. I like the format and read the majority of the articles.

I found Tim Hartnell's review of the ZX-81 particularly good. He stated that although he had supplied one or more of the games on the Sinclair cassettes, he reckons it is unbiased to say they are very good. Sorry, but in my opinion a truer description of the Sinclair cassettes would be that they are of an atrociously low standard. I have only seen the cassette 4 which I ordered from Sinclair.

On the day it arrived, a friend of mine with a ZX-81 and I both agreed that the games had been poorly designed and the flicker on graphics was terrible. Admittedly the people who designed the games had had little experience on the ZX-81 at the time. Owners of ZX-81 will assume that cassettes sold by Sinclair are the best available. Unfortunately, I think this is untrue and may also give the impression that the ZX-81 is not that good.

The cassettes, or at least some of them, attempt to be suitable for the ZX-81 and updated ZX-80. This is not very practical and despite claims, the use of Pause is not a substitute for Slow mode. A friend in Liverpool bought cassette 1 and his comments agreed with mine.

G A Bobker,
Bury,
Lancashire.

■ **Thank you for agreeing with my conclusions on the Sinclair ZX-81 — apart from my views on the software. You and your friend in Liverpool are entitled to find them of an "atrociously low standard". I do not think they are, or else I would have said so. You are right to point out that it was shortsighted not to have told the programming team that Slow was being developed, but the effect of that has been negligible. The use of Pause and Print At has ensured that the software is, in the main, compatible to both new-ROM and ZX-81 computers. Several programs, such as the very clever 1K machine code Life, were written for Fast and do not work in Slow. If you have a new-ROM machine now and you eventually buy a ZX-81 or the Compshop "Slow equivalent", you can easily remove the Pauses and put in smoother loops if you like. Do not, however, let the use of Pause blind you to the immense amount of time and care that went into developing the tracks Sinclair is selling.**

Tim Hartnell

SUBSCRIPTIONS

I recently ordered and bought a copy of the first issue of *Your Computer*. I was really astounded by the contents and if future copies are similar, you are assured of success.

However, I have a major criticism to make. Don't you think your magazine is good? Why are we not told when it is to be published and why is there no subscription form for a year's issues? I would be more than willing to subscribe.

R T Williams,
Winsford,
Cheshire.

■ **The next issue will be published on September 27 and from then on, at the beginning of the last week of each month. There is a subscription form in this issue.**

WHICH REVIEW?

I have decided to write to you after reading the first issue of *Your Computer* because — like many others, I bet — I am now completely confused over the Sinclair computer.

I will start from the beginning: 12 months ago I first encountered the ZX-80. Since I have an interest in astronomy and an even bigger interest in playing space-war-type games, I decided to look more closely at the new computer. Due to other financial commitments and an opinion that a new and better machine would be introduced to replace the ZX-80, I decided to wait for a little longer — about six months.

My interest in computers vanished as the summer approached and I thought nothing more about a new computer until March of this year when the new ZX-81 was advertised as the best thing since sliced bread.

I decided to learn more about the computer. I must say I have never seen or played a game on a home computer, I have only played arcade games such as Space Invaders. As a complete beginner, games would be an important feature of a computer, so I was hoping in the reviews for an accurate report of the ZX-81's abilities.

I am sure there are many other newcomers to computing who, when they read of a game where you have to explore a dungeon, would like to know just what is going on. The potential Sinclair buyer wants to know if the ZX-81 can also compete with games like those.

As far as reviews are concerned, this is where it became really confusing: one magazine says the ZX-81 is fantastic, another says it is not such a good bargain. After looking at five reviews of the ZX-81, I wonder if somebody could just say what the machine will do — with regards to games and graphics.

For instance, could you develop a chess program to play on the TV screen using the graphics? I think of all magazines I have read, *Your Computer* was the best for the beginner.

Keith Penfold,
Sanderstead,
Surrey.

■ **The point of a computer is that within the limits set by the design, you can make them do whatever you want. You can certainly play games on the ZX-81 but it is not capable of playing Space Invaders at anything like the level you will find in an arcade. Chess, however, is possible, and in the next issue we hope to publish just such a program.**

LOADING MYSTERY

I read with interest the first issue of *Your Computer*, especially the review of the ZX-81 as I have recently acquired one. Tim Hartnell's comments on the unsatisfactory Saving and Loading mystified me, however, as my ZX-81 is extremely good at doing both. I have noticed, however, if electrical appliances — of the kind that cause interference on radios, etc., are being used in the vicinity, then this seems to have a detrimental effect on Load.

Martyn Davis,
Loughborough,
Leicestershire. ■

Chess machines do battle

THE SECOND official world championship for chess-playing microcomputers will be held this September in Travemünde and Hamburg in West Germany. The tournament is held under the auspices of the International Computer Chess Association and the World Chess Federation. Visiting grandmasters will comment on interesting games for the public.

The tournament is open to chess programs which are executed by a readily-available, one-chip microprocessor. All computer hardware must be present in the tournament hall. There will be two groups: the first is open to any qualified contestant and will play a seven-round, Swiss-style tournament.

The second group will be restricted to computer units which are commercially available as "chess-playing computers" at the time of the tournament. The winner of each group will compete in a four-game play-off on September 28 and 29 in Hamburg. The winner of the play-off will then become the World Microcomputer Chess Champion.

The competition is limited to 20 competitors and entries are to be submitted to the organising committee by August 30, 1981. For further information contact Gerhard Piel, Trenknerweg 41, D-2000 Hamburg 52.

Vic rumours quashed

THE NEW Commodore Video Interface Computer, better known as the Vic-20, was launched at the Second International Pet Show in the normal microcomputer-industry atmosphere of rampant speculation. The rumour that few Vics were available was, however, soon dispelled by Commodore which is manufacturing the machines for the European Market at a new plant in West Germany.

The Vic stand at the show was always crowded, and the games on display were of a very high quality. The inevitable Space Invaders, together with Galaxians and several other games were almost of the same quality as the arcade machines into which money is poured daily. The big difference is that a Space Invaders machine will play only one game and set you back £1,000; the Vic is programmable and costs a mere £180.

On show, but not demonstrated, was the Vic printer, which is an 80-column Seikosha — a standard low-cost printer. It is priced at around £200 and can print 30 characters a second. Most people will, however, use the Vic primarily as the games machine it is. These people will not be so interested in a printer — what they will eventually require, though, is a floppy-disc unit. The Vic floppy-disc unit is an enigma. There are suggestions that Commodore will go for the 3½in. Sony microfloppy drives. Alternatively, Vic users might have to spend several £100 for the standard Commodore Pet drives.

John Baxter, U.K. marketing manager for the Vic, quashed both these stories when he told *Your Computer* about the Vic discs: "In effect the unit will amount to half a 3040 (the Pet floppy disc unit) and will retail for less than £300". He went on to say that he "had heard nothing about the 3½in. microfloppy".

Although the Vic has been on sale in Japan since the new year, it is not available in the U.K. until late summer. The reasons for this have much to do with the widely differing television standards. The European standard is very different to the rest of the world so the West German plant will manufacture one type, while the Japanese plant will serve the Far Eastern and U.S. markets. The U.K. version is further complicated because our television standard uses a different sound channel.

In effect, this means each Vic, before it can be shipped to its final destination, must be carefully tuned. Because, in the case of the Vic, the colour and sound are so important, this job is time-consuming — hence the delay.

The Commodore organisation is expecting to sell 100,000 machines in a year in the U.K. alone, plus the same number in West Germany and slightly fewer in other European countries. This should make them the number-one computer company in the world — at least in terms of production volume.



John Baxter, Vic's U.K. manager.



In 1980, the annual award for videogame excellence was won by Atari for the game Asteroids. It was also voted by U.S. amusement operators as the highest-earning videogame in 1980. Now Atari has launched a new version, Asteroids Deluxe. As with the original, the game can be played by one or two people at once. It has been designed to be challenging to the more skilful videogame player, while still being of interest to the novice. The display uses the Atari QuadraScan to display video graphics floating above a full-colour, three-dimensional playfield — a new feature that enhances the illusion of deep space. There is a new shield control: as the score increases, killer satellites veer on to the playfield. When hit they split into three smaller targets, which again split into two smaller craft. If the killer satellites are not enough — and they will hound your craft until they are all destroyed — players will also have to contend with smart saucers. The deluxe version of this game is bound to be popular, though it will take a long time before the world-record asteroids score of 15,449,950 points will be achieved on the new machine.

Good prospects for gold-rush

VIC OWNERS will have the chance to go prospecting with the new program from Mr Micro Ltd, a simulation of the 1849 Californian gold-rush — but at the end of the trail computer users will find real gold.

The program is a mixed-bag of puzzles, games and challenges. The first prospector to "crack the gold-rush secrets" will win a bag of genuine 22 carat gold. Even if you do not manage to find the gold, the colour, graphics and sound simulation should prove to be great fun.

To give the first prospectors an equal chance, all orders received by Mr Micro before August 26 will be despatched together. The program costs £16 from Mr Micro, Freepost Swinton, Manchester M27 1BX. The authors reckon that the solution is easily achievable, though it will take months or years before it is solved.

Adventure on the ZX-80

ARTIC COMPUTING of Hull are marketing a ZX-80 Adventure program. Priced at a reasonable £7, the program is written entirely in machine code. It is nearly 10K in size, which means the RAM Pack is essential. Richard Turner of Artic says: "It is fast and easy to play".

The game is already available for the ZX-80, and will soon be ready for the ZX-81. It is intended that this should be the first in a series of Adventure-style programs for the ZX-80/81.

Artic also sells listings of the ZX-80 ROM. Artic Computing is to be found at 396 James Reckitt Avenue, Hull, HU8 0JA.

Atom's BBC conversion

THE ROM TO convert the Acorn Atom to the new BBC Basic was due to be released in August but now unfortunately will be delayed. The new date for the release has been set to coincide roughly with the launch of the BBC computer. This will be some time in late September.

If you cannot wait that long, there will be an EPROM board available at an earlier date. While fulfilling a stop-gap role, the EPROM version of the BBC Basic will be too expensive for most computer users. Chris Curry, director of Acorn, explains: "The EPROM chips themselves are the dominant cost". When available, the EPROM version of BBC Basic will retail at around £50.

Those who own Atoms and want to upgrade to BBC Basic without having to pay the high premium for 16K of EPROM and do not mind waiting a while, will find the ROM version more acceptable. Inside the Atom case, the ROM version will require a small board whose purpose is to address the 16K of ROM required: this will be performed by TTL circuitry — the power drain will not affect the operation of the Atom.

High-street micros

WH SMITHS, the high-street newsagent chain, may shortly be selling microcomputers at its branches nationwide. Sinclair Research, manufacturer of the ZX-80 and ZX-81 microcomputers, and W H Smith are discussing a deal which could mean that micros will be sold over the counter in high streets the length and breadth of the country. A spokesman from Smiths told *Your Computer*: "We are looking at the possibility of selling the Sinclair in some of our shops".

Sinclair could not add any more information, except to confirm that talks are in progress. According to some sources, however, a pilot marketing scheme is to be launched in certain selected Smiths branches, probably only six.

The move of microcomputers away from specialist retailers into high-street multiple-outlet chains is likely to be a significant feature of the popularisation of microcomputing. Chris Curry of Acorn, manufacturer of Atom and soon to build the BBC micro, told *Your Computer* that Acorn, too, are involved in similar discussions with the high-street shopping chains.

The new Commodore Vic-20 microcomputer and the Sharp MZ-80K are two more machines likely to appear in the wider marketplace, in the near future. The chairman of the Computer Retailers' Association, Ian Dunkley of Datron Micro Centre, Sheffield, recognises the trend as inevitable: "In the long term, the increase in the width of the user base can only do the industry good". The computer retailers will have to provide support and the more sophisticated machines and applications will find this essential.

Tangerine's Tiger will include Tantel unit

TANGERINE, the British microcomputer manufacturers based in Ely, Cambridgeshire, must rate as one of the busiest companies in the country. The basic products of the company — the Microtan computer and Tantel, a Prestel adaptor — have been updated so that they will now interface with one another.

The Tantel unit can be interfaced with either the Microtan or another microcomputer. In conjunction, the two units form a colour-graphics terminal. The projected Tangerine Tiger microcomputer will include a modified Tantel unit. This, together with the possible use of BBC Basic, will make the Tangerine Tiger a very interesting machine.

If Tangerine decides to use the BBC implementation of Basic, it will probably be the first indication that this particular version of the world's most-used programming language, will be the standard version used in this country.

In a move to attract sales in the educational market, Tangerine is to offer any *bona fide* educational establishment a free Microtan computer with every Tantel unit bought. So far, there has been little response — mainly because the offer is not widely advertised. The move is an attempt to establish itself in the educational sector.

Tangerine Computers has appointed a customer-support officer to answer all your enquiries about Microtan and the Micron Computers. Paul Kaufman is the man to contact, and the number to ring is 0353-3633 or 0353-5489. He will be pleased to answer technical enquiries, and help people who have problems with their Tangerines.

In a statement to *Your Computer*, Paul Kaufman said: "Lately, the demand for Tangerine products had been so great that the company had not been able to meet the demand". This problem was mainly due to the factory being geared to meet the incredible demand for the Tantel. This back-log of orders should now be cleared reasonably quickly because of the re-starting of the Micron production line.

Tangerine is a company with a policy of providing the customer with a comprehensive selection of peripherals and add-ons. In keeping with this policy a new high-resolution graphics card has been added to the range.

The high-resolution graphics card can be used in a number of ways. One card on its own will provide a 256-by-256 black-and-white graphics display. Three cards in tandem can provide the user with a 256-by-256 black-and-white graphics display. Three cards in tandem can provide the user with a 256-by-256 colour display.

Tiny Talker, tiny price

THE TINY TALKER is a Texas Instruments microcomputer-controlled, speech-generation and production unit. Most people might consider this kind of peripheral to be outside their price range, but the Tiny Talker costs a mere £39.50.

The unit can be programmed by the supplier, BA Electronics, to customers' requirements through the selection of eight phases from a 1,000-word vocabulary. The unit is supplied with a printed-circuit board which contains a speech-synthesis circuit, a TMS 2516 microprocessor and a phrase-selection switch. For full operation, all that is required is a power supply and a loudspeaker — it works without a micro.

BA Electronics Limited can be contacted at Millbrook Road, Yate, Bristol, BS17 5NX. Telephone 0454 315824.

Slow-mode simulation

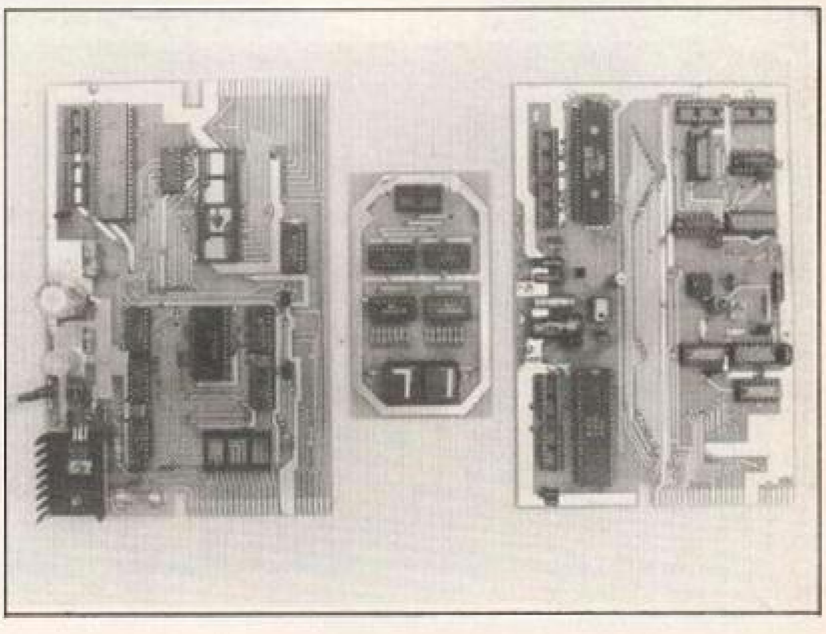
COMPSHOP, the microcomputer dealer, is working on a slow simulator for the ZX-80. It will emulate the slow mode of the ZX-81 on converted ZX-80s. The slow graphics mode enables animated displays on the ZX-81, but at the moment, it is not available even on upgraded ZX-80s.

The slow mode means that the processor works at about one-quarter the normal speed: the other three-quarters of the time is spent refreshing the video output. In this mode, the animated graphics previously unavailable on the ZX-80 are now possible. The ZX-80 upgrade consists of a drop-in ROM which gives the machine all the facilities of the ZX-81 without the slow graphics.

The slow simulator for the upgraded ZX-81 has been designed by Bill Clark, manager of Compshop U.S.A. It consists of six TTL chips on a small printed-circuit board, which fits snugly inside the ZX-80 case.

Meanwhile, JMJ Interfaces has developed a PI/O device for the ZX-80 and the ZX-81. Fitting into the rear expansion socket means that the device can be used only in conjunction with 1K of user memory. This situation will change soon when JMJ launches the projected ZX-80/81 backplane — a set of plugs which enable devices to be connected to each other and the computer. JMJ Interfaces can be contacted at Old School House, Retterdon Turnpike, Battlebridge, Wickford, Essex.

These three boards form an interface system for the UK101 and Superboard microcomputers. The system plugs directly into the computer expansion socket to provide a wide range of facilities. Among the facilities offered: user ports of differing types, a sound generator and A/D and D/A devices. The system has a 50-page booklet describing potential applications. A cassette containing 27 supporting programs is also available. Prices are: Decoding Module £27.50, Analogue board £47.50, Display board £9.50 and program tape £3.50. Contact Technomatic 01-452 1500.



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Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. Each month we will devote the page to new ideas from local clubs. We would like to hear of anything which has made a club a success, or of any projects or programs you are developing.

Fast-expanding Richmond group

This month's Computer Club features the Richmond club — a typical micro group. Bill Bennett was despatched to the outskirts of London to visit it and he reports back.

RICHMOND, a trim west-London suburb, is not like its neighbouring suburbs. Some of the area's residents met and formed a computer club. The club at Richmond is a little smaller than most, but other than in that respect, it is a typical example of a local computer group.

The club began when Robert Forster, a self-confessed microcomputer maniac, suggested to a few fellow enthusiasts that they should meet informally. To his own as much as everybody else's surprise, around 12 people attended. That may not sound like very many, but this was in June 1979 — as far as personal computing is concerned, the depths of history.

Home computing, and the microcomputer scene generally has changed dramatically since then, although the products have not much. True, the Sinclair ZX-80 and ZX-81 had not yet arrived, nor had the Vic or the Atom but the old guard of Apples, Pets and TRS-80s were all there. The popular machine of the day was the Sinclair MK14, with the 7768 beginning to wane. Both these machines are obsolete now, and have almost disappeared. They required a great deal of skill to build — in those days computer users had to understand hardware, today they just buy it.

The first meeting of the Richmond Computer Club was held at Richmond Community Centre. Everybody had to pay 20p, which covered the cost of hiring the hall, which was an ideal place for such meetings. Even though machines were a little thin on the ground, space was needed. As Robert Forster rightly points out: "Around here, more than nine or 10 people plus machines could not meet in a house". The Club expect that sooner or later they will have to use a bigger room, which luckily they do have at the Community Centre. In fact, in the two years that the club has been in existence, they have only had to raise the monthly subscription fee to 25p, and you only pay that when you attend.

These days, the club is far bigger both in size and in stature; suddenly everyone wants — or needs — to know about microcomputers. At a normal club meeting, there are about 20 to 30 interested parties present. The members of the club represent a cross-section of society, at the last meeting there were about 28 people, about twice as many adults as younger people.

The club extends a special welcome to those members who want to bring their machines with them to meetings. The members are usually treated to a demonstration of one kind or another and because of the small size of the club and the informal nature of the meetings, everyone should be able to obtain some hands-on experience during the evening.

At a club meeting, two or three machines at least are present. The club members tend to be Pet owners, in fact, between them club members own about nine Pets, two Nascom systems, two 7768s, at least one ZX-80, a Sharp MZ-80K, and an Apple. Of course, some club members do not have machines of their own; these members are either still students or are at present looking for a suitable machine, mainly by going to clubs such as this one to see what other people use.

The activities of the club revolve around the monthly meetings, where not only do members have a chance to get to grips with various micros, but the less experienced members can seek advice from the pool of knowledge that exists. At least one club member is a professional microcomputer programmer and another has worked on Pet upgrades.

The club is affiliated to the London Association of Computer Clubs, along with six other local clubs plus Imperial College, The Post Office and the Metropolitan Police microcomputing clubs. This entitles members to attend the meetings of any other of the clubs in the London area. Recently, club members manned a stand at the North London Hobby Computer Fair and as part of the Association of London Computer Clubs had a stand at the Pet Show.

Plans for the future include helping people who are following the BBC microcomputer series and some Prestel Pages. There will be some talks and the more experienced members will be willing to help those newcomers who are following the BBC series.

One of the advantages of being in a club like the Richmond one is that discounts can be offered to the members. In the case of the club in question, they are luckier still — three local microcomputer companies support the club to one degree or another. Discounts are given to the club members by Microfacilities, the Twickenham Computer Centre and SBD software.

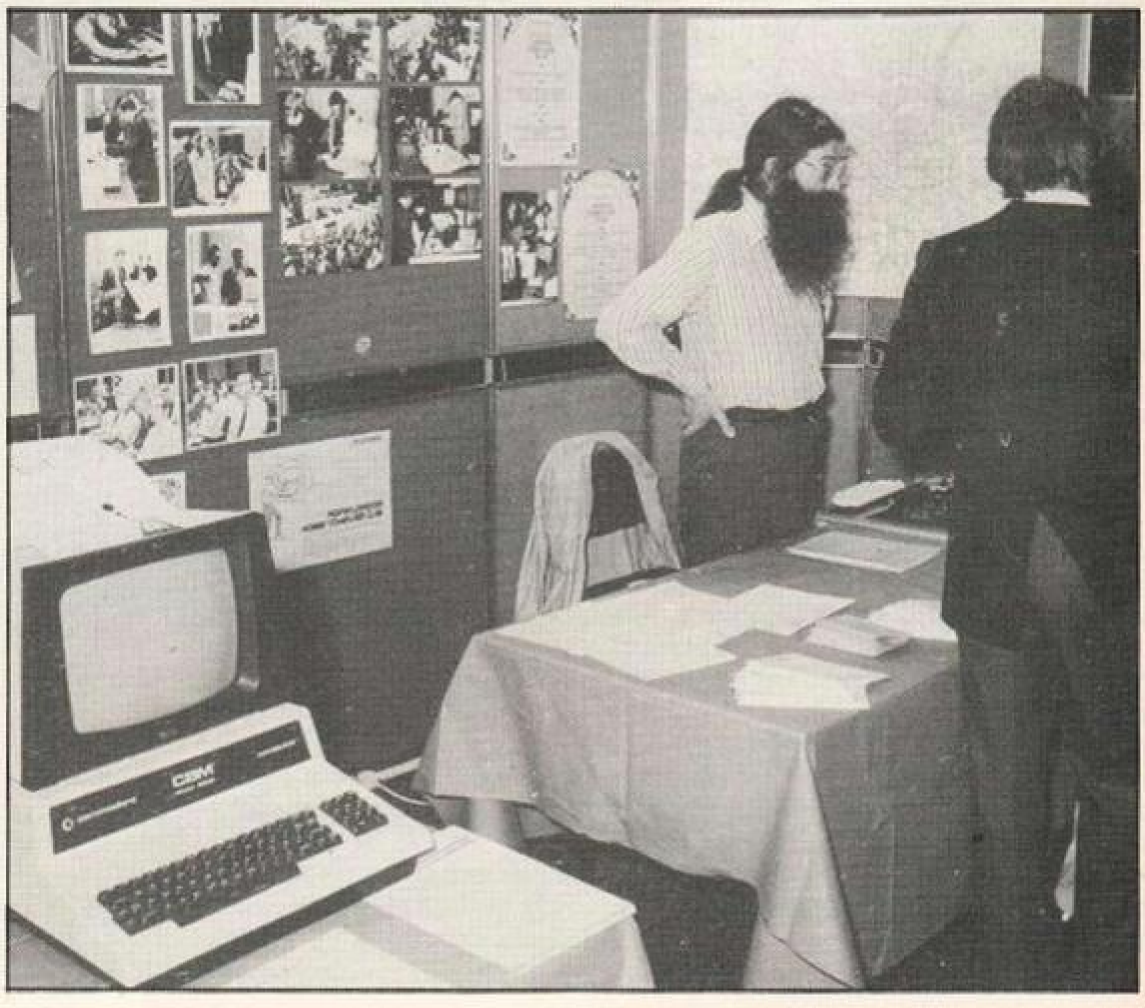
The Richmond Computer Club meets the second monday of each month at the Richmond Community Centre, Sheen Road, Richmond. For further details telephone Robert Forster on 892 1873 after 7 pm.

Orpington people

THE ORPINGTON ZX-80/81 Computer Club meets each friday — at present in members' homes and although the membership at the moment is small, it is most enthusiastic and knowledgeable.

More members would be welcome, particularly those new to computing who can learn and see just what this little machine is capable of. Those interested should telephone in the first instance for details of the time and location of the next meeting: R A Pyatt, 23 Arundel Drive, Orpington, Kent BR6 9JF. (66) 20281.

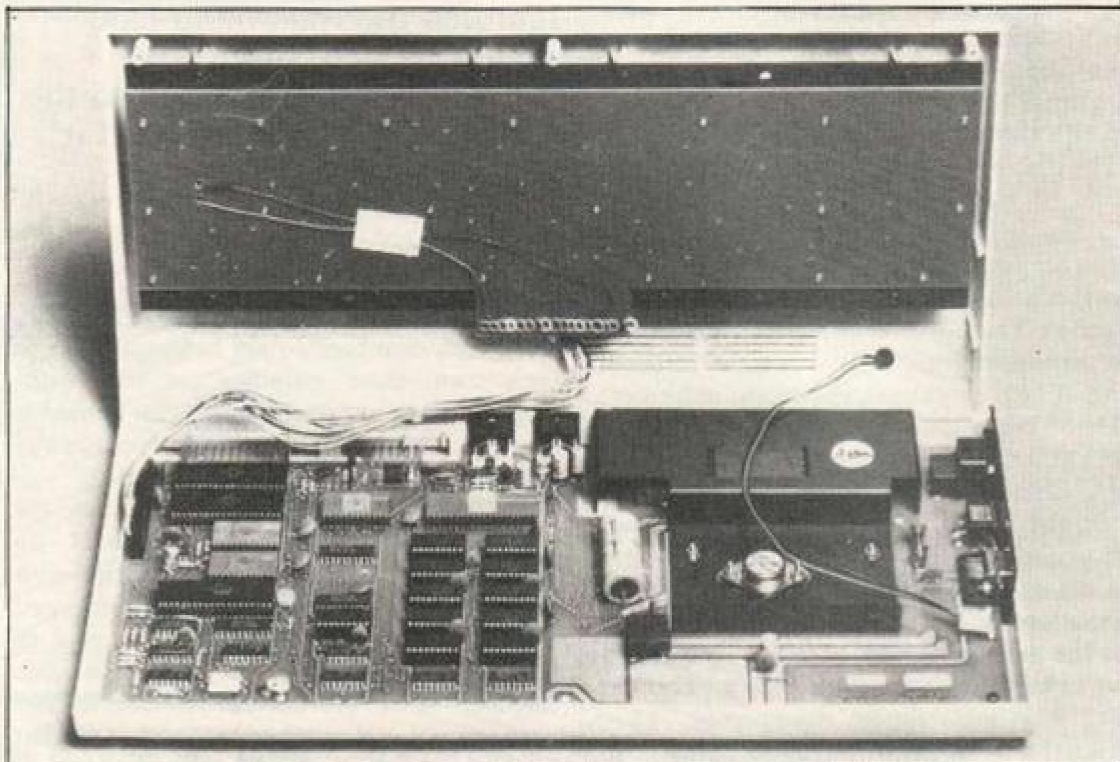
Richmond Computer Club is part of the ALCC who manned this stand at the 1981 Pet Show.



REVIEW

COMMODORE VIC~20

The Vic offers features such as high-resolution graphics and yet costs between half and one-third of the price of machines boasting the same facilities. Nick Hampshire assesses this, the latest addition to the Commodore stable.



VIC IS THE first true consumer computer to be produced by Commodore, the company which makes the very popular Pet computer. A consumer computer is a machine which is marketed at a price between cartridge-programmable TV games and low-cost computers like Pet and Apple.

It can be used as a TV games machine — games cartridges are available — or as a computer running commercial programs or programs the user has written himself. As a computer, the Vic is comparable with machines like the Texas Instruments TI-99, TRS-80 Colour computer, and the Atari 400 which all cost two or three times its price.

The Vic is, in fact, derived directly from the Pet and uses the same versions of Basic. The machine allows almost anyone to become involved in computing quickly, easily and with little expense. The designers of the Vic have built in sufficient expansion features which allow the machine to grow with the user as his knowledge and requirements expand.

It will appeal to people of all levels of computing expertise from the computer professional to the TV games enthusiast who has a desire to learn computing and write his own games.

The Vic, which stands for Visual Interface Computer, is designed to use an ordinary domestic colour TV set as a display. A black-and-white set can be used, but the colour display capabilities of the machine are obviously forfeit. The basic system consists therefore of the Vic, a colour TV and the Vic power pack.

The entire computer is housed in a keyboard unit featuring a full-size typewriter-type keyboard mounted in a cream-coloured plastic case. The keyboard is almost identical to that used in the larger Pet machines, but instead of the separate numeric keypad it has a set of four user-definable function keys.

As with the Pet, the keys are legended with both alpha-numerics and the graphics character set. In fact, there are two graphics symbols on each key which are displayed by pressing the key plus one of the two shift keys. Which of the two shift keys is pressed determines which graphics character is displayed.

The Vic has a memory-mapped video display which means that the programmer has total control over positioning characters on the screen without the need to erase and re-write. The screen is stored as a block of 506 bytes of memory, with a parallel 506 bytes used to store the colour code for each character.

The entire video display is controlled by a single, very-sophisticated integrated circuit called the 6560 Visual Interface Chip after which the Vic is named. The 6560 is entirely under the control of the programmer which gives him great flexibility in the formatting and choice of displays.

The Vic has three display modes; text, multi-colour and high-resolution. In text mode, the display shows 23 lines of 22 characters, a total of 506 characters. The 22 character line may be rather small for some applications, but when writing programs this is overcome by using four lines of the screen to contain each program line. This gives an effective line length of 88 characters.

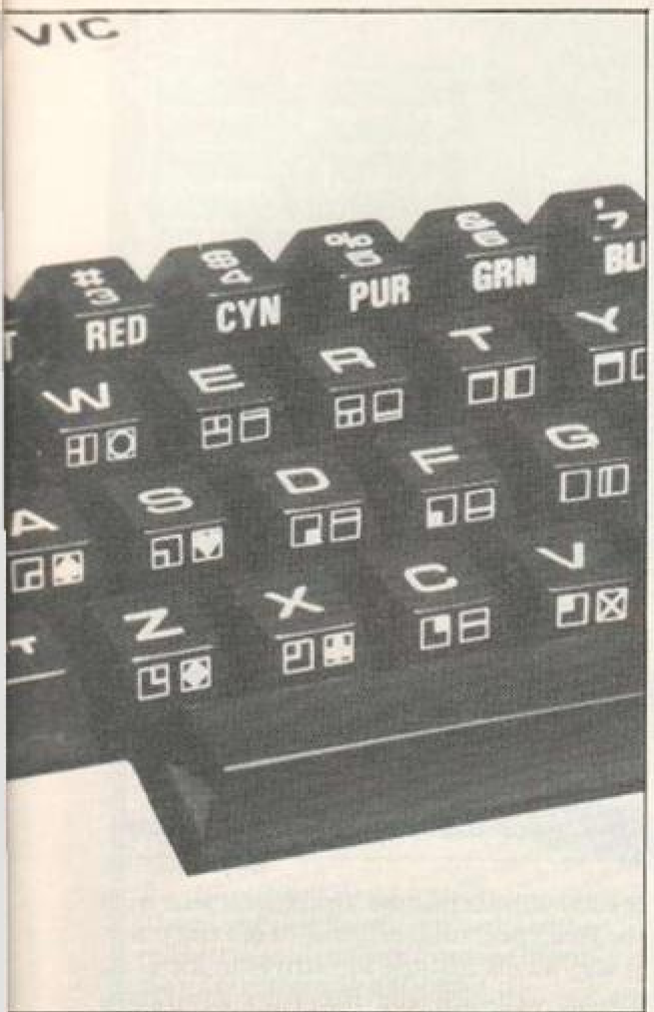
In text mode, each character can be in any one of eight colours, in addition there are 16 different screen background colours and eight border colours a total of 255 different colour combinations. In the multi-colour mode, the screen has a resolution for plotting of 88 by 160 — half the high-resolution figure.

Each character space in multi-colour mode consists of a matrix of eight-by-four plottable points, and each point within that character space can be in any one of four colours designated by the programmer.

In the high-resolution mode, the screen has a resolution of 176 by 160 plot points. Each character space consists of an eight-by-eight matrix of points, any of which can be in one of two colours designated. The high-resolution mode can also be used to create a user-defined character set such as specialised mathematical symbols for use with a text, multi-colour or high-resolution display.



The Vic is supplied with 5K of RAM memory of which 3.6K is available to the user for Basic programs, the other 1.4K is used to store system variables, cassette buffer and the screen memory. RAM memory can be expanded by using plug-in cartridges which allow the user memory area to be expanded up





to 32K. This can be either all RAM or a mixture of RAM and ROM.

The basic memory expander cartridge has 3K of RAM which boosts the user memory area to 6.6K, plus two empty ROM sockets used to store up to 16K of programs in ROM. Further expansion of RAM memory can be achieved with the 8K or 16K expansion cartridges and/or the master control panel which allows more than one cartridge to be plugged into the expansion port.

Programs can be stored on tape using a Pet-type cassette deck attached to the cassette port on the Vic. Unlike the Pet, the Vic can be attached to only one cassette deck, so file updating must be done in memory. Programs are stored on the Vic using the same format as programs stored on the Pet — this means software is transferable.

A very low-cost, single-disc drive and dot-matrix printer are being produced for the Vic, much less expensive and simpler than the devices currently available for the Pet. The Vic disc drive will be compatible with the Pet disc drives so programs and data on disc will be also interchangeable.

These devices will use the IEEE 488 interface on the Vic. This is not a true implementation since it uses serial data transmission. A true IEEE 488 interface is available as a plug-in cartridge on the expansion port. With this, one can connect the Vic to the Pet peripherals, Pet-based networks like MuPet, and any of the countless different instruments using this interface.

The Vic also supports a RS232 interface which is designed for use with a MODEM to allow Vics to communicate via a telephone line. This feature will eventually, when given Post Office approval, allow the creation of a whole range of communications services between Vic users: electronic mail and messages, information and database access among others.

The Vic can be used as a controller for any type of equipment from model train sets through laboratory experiments to industrial processes. It can be achieved using the programmable user port which gives the user an eight-line I/O with two handshake lines which are each individually-programmable as input or output.

The user port lines are from one of the two 6522 I/O chips which are versatile integrated circuits that place many useful features at the programmer's disposal.

The 6561 visual interface chip not only controls the video-display generation but also provides the user with several useful I/O functions. For example, a light pen can be connected to the Vic, a suitable device is being produced by Commodore and this will allow interactive graphics programs to be run.

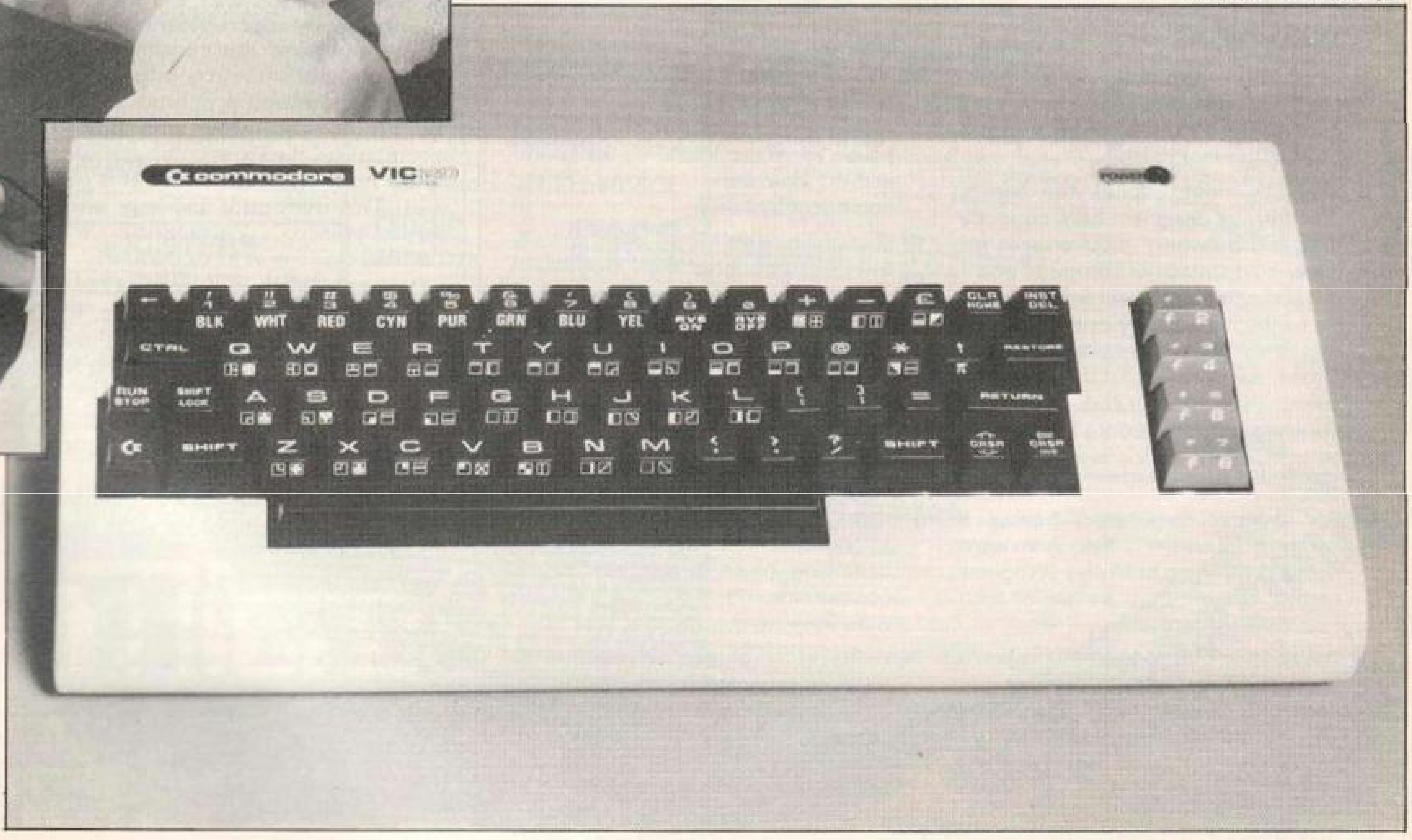
The second function is the provision for connection of rotary paddles and joysticks which make the Vic a true consumer computer.

The last of the additional features of the 6561 is its programmable sound generator again of primary interest to games players. The sound generator is output to the speaker of the TV being used as the display and consists of three independently-programmable tone generators, each with a three-octave range plus a variable-frequency source of noise. By using all four generators together, very complex sound effects or multi-part music can be created.

The operating system and Basic occupy 16K of ROM in the Vic: the operating system occupies 8K and Basic occupies the other 8K. The Basic used is identical to that used in the 3000 series Pet with slight modification to allow for a changed operating system.

Since the Vic system architecture is very different to that of the Pet, the operating system also differs although to the user, it appears

(continued on next page)



(continued from previous page)

identical. This means that any Pet program which can be made to conform to the narrower-width screen and which is written entirely in Basic with no Peek, Poke or machine-code subroutine calls will run on the Vic.

Any Pet program using machine-code and system subroutine calls or system variables must be re-written to change these to the new locations used by the Vic.

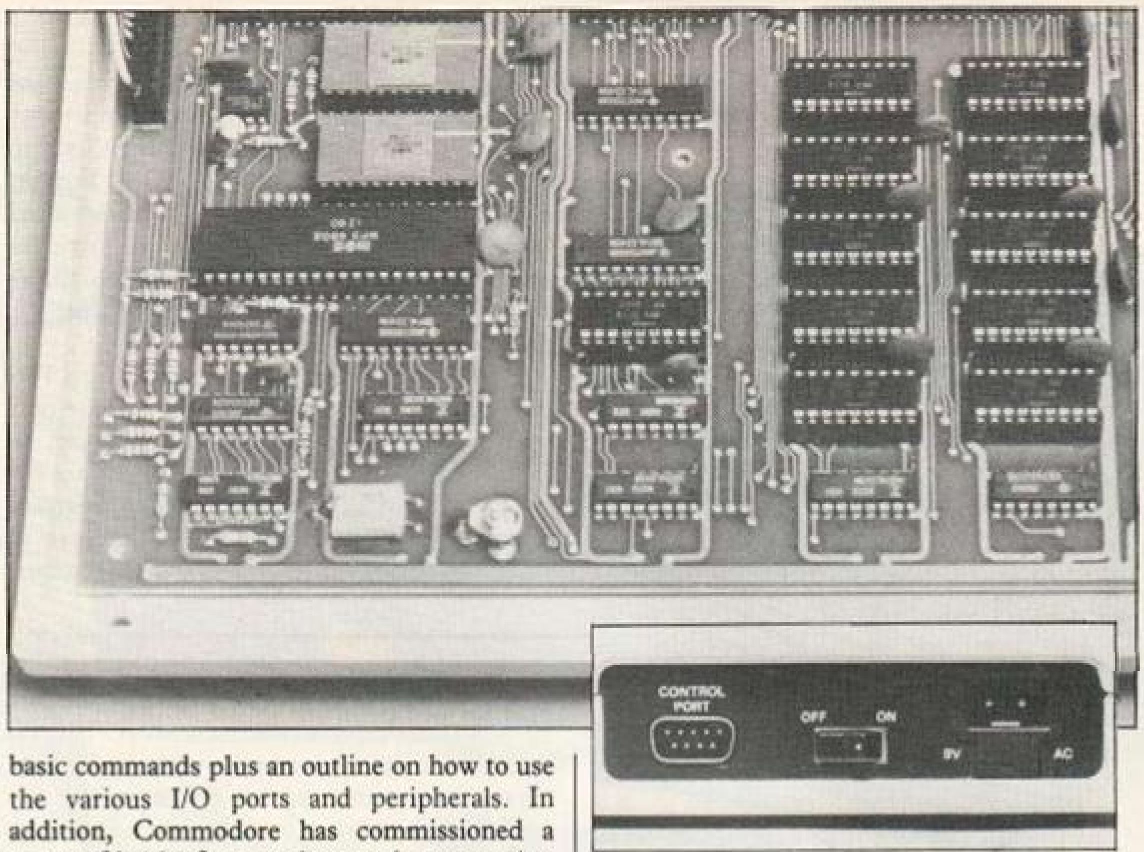
The Basic used by the Vic is both fast and powerful — in fact, the Vic runs at twice the speed of the Pet, since it uses a high-speed version of the 6502 microprocessor. It is a nine-digit full floating-point Basic capable of handling numbers in the range E-38 to E37. All trigonometric and log functions are provided and all are calculated to nine-digit accuracy.

Full string-handling and manipulation capabilities are provided and the only limitation is a maximum 88-character input. Machine-code subroutines can be run within a Basic program and all memory locations are accessible and alterable by Basic.

To aid programmers, Commodore has produced two special cartridges for plugging into the memory expansion port — the Vic Programming Cartridge and the Super Expander Cartridge. The Vic Programming Cartridge contains a ROM plus an extra 3K of RAM. The ROM contains a machine-code monitor, allows toolkit commands and function-key programming.

The Super Expander Cartridge adds a set of commands to Basic covering high-resolution graphics, and music, plus an extra 3K of RAM. For Vic users who are not familiar with programming, Commodore has developed a range of self-teaching books with associated plug-in cartridges.

For everyday use, there is the Vic programming guide. This manual covers all the basic commands plus an outline on how to use the various I/O ports and peripherals. In addition, Commodore has commissioned a range of books from various authors covering the more advanced concepts of Vic programming and applications.



The Vic is a well thought-out and developed product, and enters the U.K. market well tested by one of the toughest consumer societies in the world, Japan. Commodore has marketed the Vic in Japan for the last 10 months. The theory behind that decision is that if you can sell a consumer electronics product to the Japanese successfully, it must be good.

The Vic has been very successful in Japan selling more than 10,000 machines a month and still increasing. In the light of this, Commodore's aim of selling a similar volume of machines in the U.K. seems not unreasonable.

It also indicates that the Vic fulfils at least what the Japanese consumer demands of a computer. It also means that the Vic arrives in the U.K. market well-tried and free from any fundamental design faults.

The Vic is intended to bridge the gap between the low-cost hobby market and the home or small-business computer market. As such it should appeal to a wide range of potential users, including:

- The hobbyist who previously could not afford a computer.
- The first-time computer user who wishes to learn about computing.
- In education, where the low-cost and Pet-compatibility will appeal.
- In industry, laboratories, and process-control which require cheap off-the-shelf computers.
- As a telecommunications terminal.

Because most of the very extensive range of software and add-on peripherals available for the Pet will be usable with little or no modifications, the Vic will find applications in all the many areas where the Pet is currently used. This ready-made and large market for support products will give the Vic a considerable lead over any of its competitors.

Documentation is an area where Commodore has in the past had a poor reputation. With the Vic it looks as if Commodore is trying to remedy the situation. There are three levels of documentation: basic system documentation; self-teaching courses in programming; and advanced application and programming guides.

Only the first of these documentation levels has so far been produced the other two levels are still in preparation. The documentation covers progamming the Vic in Basic with full explantion of commands and syntax — a whole page is devoted to each command.

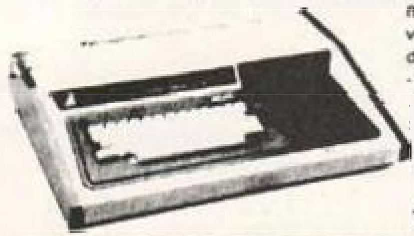
Besides the Basic commands, the manual covers file handling I/O commands, programming the RS232 port, and all are illustrated with example programs. From the advanced specifications for the other two levels of documentation which I have seen I would say that they should be reasonably good. ■

CONCLUSIONS

- The Vic is a well-designed and well-produced consumer computer at a price which makes it one of the best buys currently available.
- My only doubt about the Vic is whether the designers have correctly gauged consumers' requirements for a low-cost consumer computer and if so, is the timing correct for its launch on to the market. My own opinion is that they have a product which is almost correct and that the timing for its launch is probably about right; it all depends on Commodore's marketing as to whether the Vic is a success or not.
- For anyone considering buying a computer, whether to help them learn about computing or to play computer games, the Vic must be one of their first choices of machine.
- Reliability seems to be good thanks to the relatively small number of components used in the machine. In five months of reasonably heavy use of the Vic, I have not had any problems.
- Market support for the Vic is bound to be very extensive given its close relationship to the Pet. This should cover all areas including software, add-on hardware, servicing, books and documentation.
- Availability: the Vic is being initially marketed through about 100 outlets in the existing Pet dealer network. Later this year it will be marketed through high-street stores.
- Though not the least expensive, the Vic compares very favourably to other products on a feature-by-feature basis. What is standard on the Vic is very often an optional extra on other lower-cost machines. It is interesting to note that Clive Sinclair when launching the ZX-81 said that the only competition that existed for his machine was the Vic.
- By using the plug-in modules on the memory expansion port, the Vic can be expanded to a full-sized system. By adding Pet peripherals to the Vic the Vic can be used as a stepping stone to aquisition of a full Pet system.

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Tantel opens the line to Prestel

BY PETER BLOWER

Until recently, the equipment required to receive Prestel and viewdata has proved prohibitively expensive for most would-be users. Now Tantel has released a £170 low-cost alternative which Peter Blower tests for value and reliability.



THE DEVICE tested contains an issue 2 board carrying Version 2.2 EPROM. The whole board is small, but heavy for its size — 243mm. by 165mm. by 58mm. weight: 2kg. — and has three leads connecting it to the outside world.

The case is of a two-part pressed steel construction, well-engineered with welded corners. The top half, including the keypad, is completely covered by a moulded-plastic shroud. This makes it thoroughly rainproof and it should survive the occasional cup of coffee poured over it.

The plastic cover is fixed to the base by six screws along the side and back. In my view, the screws detract form the clean lines of the case and have sharp edges. The plastic also looks as if it may become brittle if left persistently in strong sunlight. An injection-moulded case with self-latching teeth on the inside would be better — particularly for mass sales to the U.S. as the Americans tend to be somewhat particular in this area.

Positive action

The buttons are of the castanet type, bonded to the topmost plate and have a positive feel. They are covered by a thin film of resilient plastic which allows the fingers to feel the castanet switching action. The through-hole plated printed-circuit board is well-constructed and silk-screened. The under-board tracking makes it suitable for wave soldering.

Apart from the keypad, all the components are mounted on a single board. The board contains the mains and Post Office line transformers, ASTEC colour modulator, relays, processor/video area and MODEM/tape interface. Together with its strong base, it should withstand a fall from a table to a carpeted floor without much difficulty.

The MODEM/tape interface area contains a special MODEM chip and filtering circuits. There are upwards of 50 resistors, an assortment of capacitors, transistors, etc., and it looks very complicated. This area of the board must be expensive to build and I noticed a few modifications. I am sure that the makers are just as anxious as I am to see MODEM-filtering ICs become available.

There is no on/off switch supplied nor are there "mains on" or "telephone line in use" indicators.

The mains supply enters the board via a plug and socket. In the event of an improper connection, there is a risk that the case would not be earthed. For this reason, I would like to see a separate earth bond to the case or a special plug and socket where the earth is the last to be disconnected.

The dial-up, user-identity and password numbers are held in memory, supported by an on-board battery for the time the adaptor remains unplugged from the mains. Should the battery fail or run down, all the stored numbers will be wiped.

In the case of failure, the whole unit would need to be sent back to the manufacturer or supplier. Where the battery has run down, a charging period of 12 hours will restore it to full health, but a call to the Prestel registration office is still needed to re-register the adaptor.

The instructions are in the form of a six-page pamphlet. They are concise and easy to understand, but there is no helpful guidance as to what to do should the adaptor become faulty, nor is there an address or telephone number where the unfortunate user can go for help.

Outside world

Before anything happens, the Tantel adaptor must be connected to the outside world. The three connections are simple enough: one to the telephone jack socket, one to the television and one to the mains socket.

The telephone-jack socket is individual to Prestel and must have been previously installed by British Telecom. A small rental is charged. The dealer will normally register the Tantel for you.

Assuming the television is tuned in to the frequency the adaptor uses, the Tantel logo followed by six dialling options should appear on the screen. These dialling options are pre-recorded telephone numbers which dial the various Prestel and viewdata computers for you. Having chosen the option you want, it is a matter of pressing the option number on the keypad followed by a #.

A dialling message appears on the screen together with the sound of the telephone call. If the call is unsuccessful, an internal timer will disconnect the line automatically. A successful call cuts off the sound and blanks

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the screen for a number of seconds. In that time the user number and password is sent to the computer. All being well, the computer will recognise you as a valid, fee-paying customer and will welcome you.

The quality of the display is very impressive. Not only is it superbly clear, but the colour balance is very close to ideal. No alteration to the TV colour controls is necessary in changing from normal TV programmes to Tantel and *vice versa*. The quality can never be as good as direct RGB signals working to a properly-equipped monitor, but that said, the colour circuitry and modulator is of high quality and it shows in the display. In this case, the final viewing rests with the TV.

Vision noise on the TV sound channel I found to be quite disturbing — not a major fault, but one that should be rectified. One problem I have encountered with many Prestel sets is that while a frame is being formed on the screen and a new frame is called, the new frame sometimes starts from the point on the screen from which it was called. It looks most confusing and takes an agile mind to resolve the mess. No matter how I tried, I could not muddle the display or do anything other than what it was supposed to do — all credit to Tantel.

The positive clicking action of the keypad switches turned out to be quite important. The Prestel system, in common with many computer systems, sometimes takes up to a few seconds to react to your commands. The system cannot afford to throw away your input commands, so it has to store them.

If you send a command and are unsure whether it was sent — because the system has not yet responded — then the natural thing to do is to send it again. When this happens you do not obtain the frame you wanted but the one after. With Tantel, once the click of the keypad is felt, you can be sure that the command has been sent and the Prestel system will respond in the end.

The BCS, big-character select, button takes either the top or bottom half of the displayed page and expands it to twice the normal height. This is a useful facility if you have poor eyesight or are suffering from eyestrain.

The REV, Reveal, button allows you to reveal any concealed text on some frames. By pressing the DIS button, the Tantel disconnects itself from the telephone line and displays "line disconnected" on the bottom line. The frame on the screen remains — useful if it needs to be studied for any length of time. Pressing # allows you to return to the Tantel menu page.

When the Prestel system disconnects, the Tantel adaptor waits a few seconds before it disconnects itself. In the meantime, however, the line is dead and the adaptor continues to display anything it receives. Visually, it is disconcerting. The only way round this, is to anticipate it by pressing the disconnect button yourself, but, for some reason, the "line disconnected" message does not then appear.

Each character sent down the line has a parity protection bit sent with it. The adaptor seems not to do any error checking, so the poor viewer must do the error checking himself. It would be a useful feature if a "line noise" message appeared on the bottom line if bad characters were received.

The menu page allows the choice of six programmed numbers. Incorrect entries give you a "please try again" message. However, if one more character is entered above the allowable maximum, this message appears and



the menu displays the number just entered with the last character overflowing on to the next line. A minor fault, but one which ought to be resolved.

The tape facility enables displayed frames to be stored for later viewing. It takes a little practice to set the correct recording levels. Pressing the tape button disables the keypad and the screen. A tape message appears on the bottom line while the screen information is being transferred. This is followed by a saved message when the transfer is complete. I noticed that the keypad does not become active for about a second after the saved message appears.

Only after the Tantel is disconnected from the telephone line is it possible to play back the recorded information. It is not possible to record any dynamic frames. The tape output can also be used to drive a block graphics printer, provided it can understand the signals sent to it.

The tape interface uses the CUTS standard transmitting and receiving at 1,300 baud. I am told that a slightly faster speed than 1,200 baud had to be used for technical reasons concerning the MODEM chip. As good as this product is, I can see many potential buyers, with computers or printers in mind, shying away from a non-standard 1,300 baud interface.

One corner of the adaptor grows a little warm after it is switched on. Those people who are blissfully ignorant about the wonders of electronics might believe that their brand-new possession is overloaded and is about to die. In fact, the power regulator is bolted to the case in that corner and uses the case to lose the excess heat.

In design terms, the positioning is sensible; alternatively heat-sinks, extra holes, nuts and bolts, etc., would have to be used which would increase the price. Perhaps a reassuring comment in the instruction booklet might put minds at rest.

The cables, if not kept in some order, can become an awful muddle. The sales brochure shows them neatly taped at regular intervals. Knowing that the adhesive insulating tape can become slimy after a period of time, I decided to loosely plait the three cables instead.

The cables do not look as long as the ones in the brochure, but what could I do with all that cable anyway? The aerial cable is the shortest at 6ft. Tantel could have been more generous and supplied a 10ft. cable instead.

Because of the British Telecom approval procedure, direct V24 or current-loop connections have not been provided. The tape interface becomes the only realistic means of connecting to an external keyboard or computer. However, with the interface speed set at 1,300 baud for some potential buyers, external connection might prove to be pointless and hence sales may be lost.

If computer connection were made possible, then a facility to allow two computers to communicate with one another via their Tantel adaptors would be a definite selling point. It would be necessary, though, for each Tantel to send and receive at the same speed.

Of course, if easy connections to a computer were possible, then telesoftware would be that much more easily implemented. Also information pages could be loaded into a kind of word-processing software to be printed later in some convenient form better suited to the A4-sized paper world we all live in. ■

CONCLUSIONS

- At £170 + VAT, Tantel offers a simple and reliable alternative to the more expensive combination Prestel/Ceefax/Oracle TVs.
- Tantel appears to be excellent value for money and combines simplicity of operation with quality of display.
- The positive feel of the keypad reinforces the favourable overall impression created by the solid construction and clear and concise instruction manual.
- Among Tantel's shortcomings are its lack of separate internal earth bond, mains of/off switch, power-on or line-in-use indicators.
- The system has a non-standard CUTS interface and no advice is given should repairs be necessary.
- There is no line-noise message and the keypad locks out after "saved" message.
- Tantel displays rubbish when Prestel disconnects first and the TV sound channel is noisy.
- The aerial cable is not long enough.
- Tantel plans to issue new versions of EPROM software which will allow more facilities, such as computer connection to Prestel via Tantel.
- I foresee many schools and colleges buying a Tantel as a Prestel adaptor, a MODEM link between computers and as a means of gathering telesoftware from Prestel and other viewdata centres.
- A standard CUTS interface may prove crucial to Tantel's future success.

• Circle No. 111 ▶

The VIC centre
It's the add on to start with for your VIC-20

When it comes to looking at what the incredible VIC-20 has to offer, there's one cost-free add-on it will pay you to consider right from the start – The VIC Centre. Established by Adda Microshops Ltd, part of the successful Adda Computers group, The VIC Centre aims to offer the kind of service you'll not find anywhere else in the country.

To begin with, our business is dedicated towards providing you with a "one-stop" source for the VIC-20, VIC-20 peripherals and VIC-20 software. On the basis of a very simple philosophy: to provide a friendly, fast and comprehensive service for the world's most user-friendly and helpful personal computer.

We'll be amongst the first to have available supplies of the VIC-20 with its magnificent sound and colour capabilities.

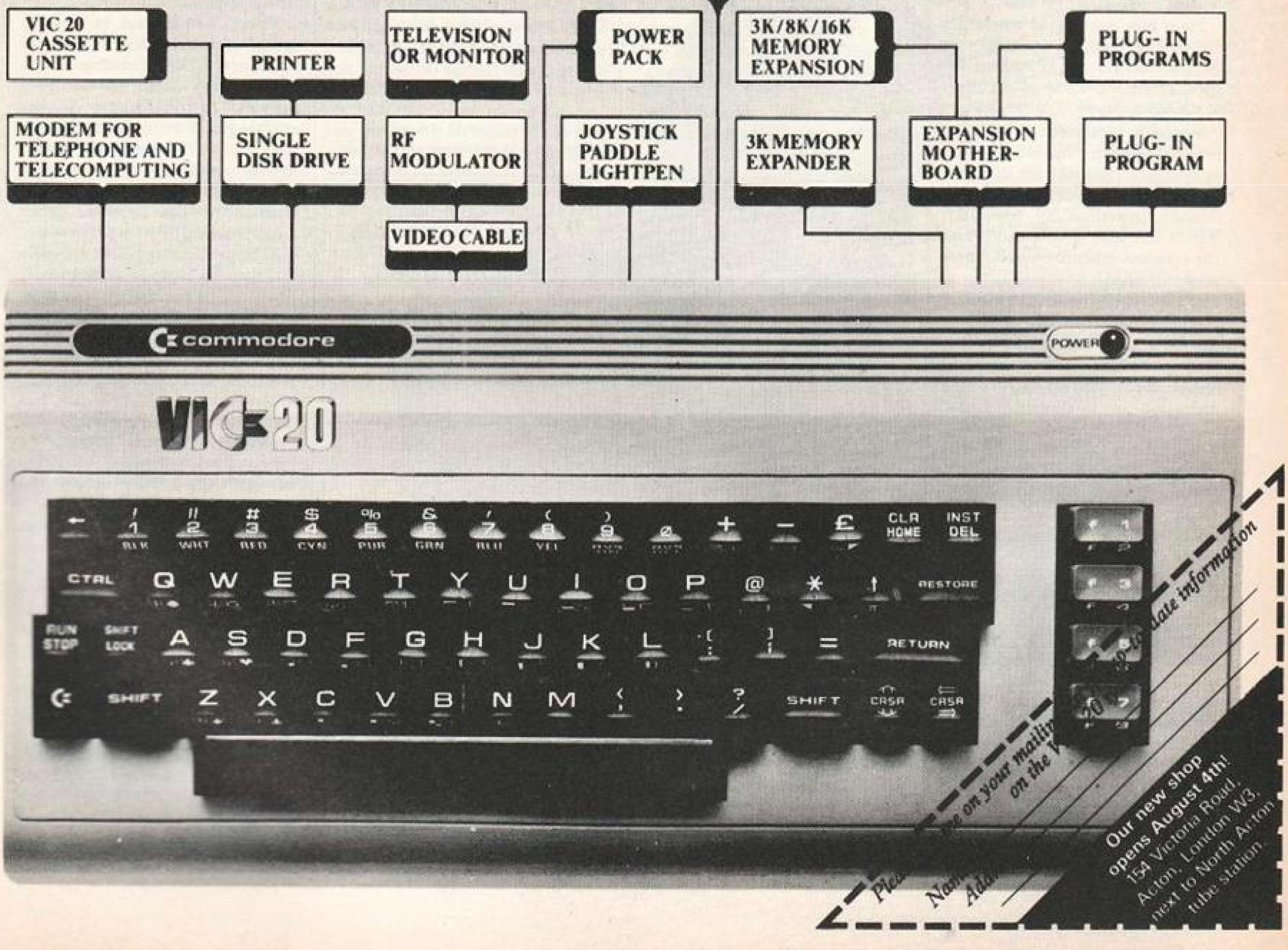
Contact us now to ensure early delivery of your VIC-20. When you've found how the VIC-20 makes it easy for you to learn all about computing, we'll supply the software to help your knowledge grow.

We'll keep you informed of new peripherals which will give the VIC-20 system unrivalled versatility on applications ranging from home budgeting and video games to business records and statistics.

All our customers benefit from our telephone technical advisory service and in-store repair facilities.

If you want to get to the heart of what the VIC-20 system is all about then go straight to the centre – The VIC Centre – and join our information service now.

Just complete and post the coupon. Or telephone 01-579 1962.



Our new shop opens August 4th! 154 Victoria Road, Acton, London W3, next to North Acton tube station.

INTERVIEW

CLIVE SINCLAIR

CLIVE SINCLAIR started business by making hobby electronic kits and scientific instruments but is better known for his breakthroughs in consumer electronics products. His achievements include the first pocket calculator — so successful that at one time his company was Europe's largest manufacturer of calculators.

He also created the world's first electronic watch, the Black Watch, which proved the enormous potential demand for such a product. The watch was, however, so dogged by production failures and apparently poor quality control that it was quickly withdrawn from the market — then the foreign competition stepped in.

He made Microvision, the first almost pocket-sized television, now sold by the National Enterprise Board. Earlier this year he announced a new breakthrough with the first flat-screen television, due to go into production next year.

He is now working on an electric car and is studying economics at King's College, Cambridge, in the hope of testing some of his ideas about job creation.

Sinclair's breakthrough into the personal-computer market occurred in February 1980 with the launch of the ZX-80 which quickly became the world's largest-selling computer. Earlier this year, he followed it with the even less expensive and far more powerful ZX-81.

Clive Sinclair was recently appointed the chairman of British Mensa, a lodge which believes that intelligence can be measured and quantified. "Surely IQ is the definition of intelligence", says Sinclair. "There is no doubt that whatever it is that intelligence tests are measuring, it selects people I find a sight easier to get on with than the average".

Sinclair has had no formal training in any of the subjects he has worked in: "I taught myself electronics at school from textbooks. When I left school in 1958, I chose not to go to university because most of them only offered electrical engineering and I had no desire for such a broadly-based course.

"I had written for the magazine *Practical Wireless* while I was still at school. So when they advertised a job, I joined. The title was editorial assistant but dog's-body was what it was. There was an editor, an assistant editor and me.

"The editor became very ill and retired so the assistant editor stepped into his shoes and promptly had a nervous break-down at the thought of having to work with the great F J Cams who had started the magazine. I was left running it on my own — it took about two days a week.

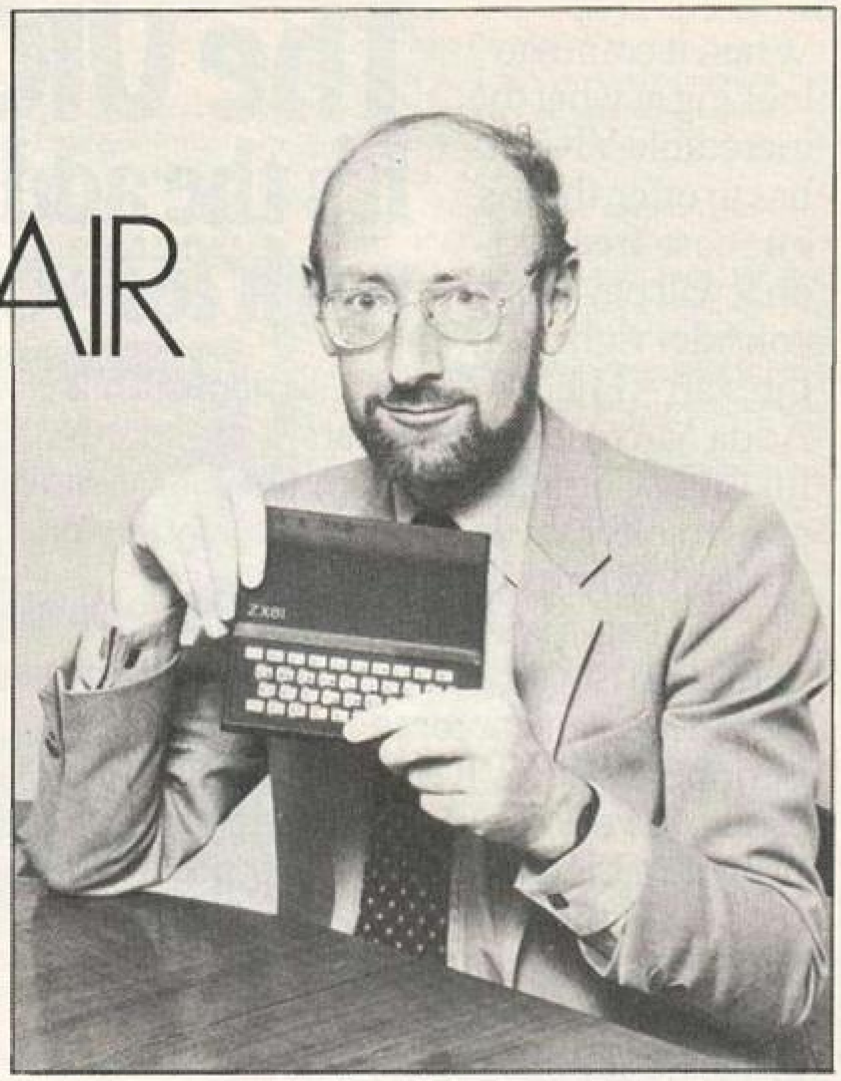
"As a result, I was offered the job of running a little publishing firm called Berners. I did that for three years while I worked towards making a transistor-radio kit. Transistor radios were starting to enter the market. The Japanese were just beginning to become a force to be reckoned with but the import controls did not allow them into the country.

"I tried to raise funds: I, in fact, persuaded a company to back me and I left my job but they got cold feet and it fell through. I looked around for money for about nine months doing some freelance writing. I took another job and started practising electronics in my spare time until it was going well enough to support me.

"The first thing I did was to buy transistor components from Plessey. It was making transistors for the computer industry and had very tight specifications. It had many transistors which were perfectly good but did not meet that particular specification so I bought, tested, graded and sold them.

"The next idea was an amplifier kit, followed shortly by a radio kit. Those products went reasonably well and we moved into stereo kits. I went into kits because as a mail-order business, I could sell them without much capital. It put us firmly into the hobby market.

He is one of the few makers of personal computers in Britain whose name is known to millions. Many admire him for his inventiveness: some distrust the ephemeral quality of many of his products which, however well-designed, are launched on a market which is increasingly resentful of poor reliability. He talks to Duncan Scot.



"We had some very innovatory designs from the technology point of view, such as a new type of tuner. We started to sell ready-built stereos to the shops and that developed into a medium-sized business which took us through to 1972 when we launched the first pocket calculator.

"The pocket calculator was the first one in the world. Its success was so great that its sales totally overshadowed the stereo business. At the same time, we moved into making instruments.

'I make mistakes, everyone does, but I never make them twice'

"The calculator market was very interesting; there was no precedent. When we started, calculators were sold exclusively through office-equipment shops. Although we sold some to those shops, I believed that that was the wrong kind of outlet. In principle, we needed mass-merchandising so we approached Boots. It seemed an unlikely choice at the time, but Boots had a very large chain. We also approached W H Smith.

"The breakthrough into calculators occurred because two or three companies more or less at the same time had developed single chips which contained most of the logic for a calculator. You could only make a calculator of a large size because the power consumption was far too high.

"What we did was to develop special circuitry which effectively switched the calculator chip on and off in a way which had not been intended in the design. It was effectively off for most of the time but the charges on the various devices remained until they were switched on again and so the data was retained. That meant we gained a power saving of 10 or 20 to one.

"The problem we faced eventually was that the Japanese released little liquid-crystal machines. At one time, we were planning a diverse machine which used liquid crystals but to drive them, you need CMOS chips and those were made only in Japan. Whereas when the Americans had the lead in calculator chips they were prepared to supply to us, the Japanese were only willing to supply last year's chips. They support their own manufacturers.

"That was one problem; the other was that the calculator business became fiercely competitive for everyone; everyone was selling at a loss. The big companies could afford to sell at a loss; we couldn't as it was our main business.

"Our instrument business was working in parallel. Although it was less spectacular as far as the public was concerned, it grew to be a reasonably substantial business.

"Then we unveiled the Black Watch. That was technically very exciting. We were the first people in the world to put all the electronics of a watch on a single chip. Originally,

we worked with Mullards but it backed out of the program — it couldn't see a future in electronic watches. So we turned to ITT to make the chip.

"We hit technical snags in production. That was disastrous for us as we had launched the product, created the demand and couldn't deliver. We suddenly discovered that static electricity could switch the chip.

"We hadn't discovered it before because by sheer chance, all the time we were making the pilot units, the humidity had been reasonable and so there were no static problems. By the time we launched, the humidity was very low and people were having electric shocks when they walk across carpets and damaged their watches.

"There were other production problems which we couldn't solve and we never produced the yield we needed. The problems of the Black Watch fell at the end of the 10 years we had been developing our pocket-television technology — which was an enormous investment for us.

"On top of that, we had the flat-television tube project — jointly financed by us and the National Research and Development Council. We had the choice of either reducing the size of the company and dropping that project or seeking outside finance. I decided to go to the National Enterprise Board because the project was so dear to me.

"We were unsuccessful. When Lord Ryder was the chairman, he backed us because of the television project. He left and the new people decided that the future lay with our instruments not with consumer electronics. They didn't think we could compete with the Japanese. Eventually we split up.

"We were developing a personal computer at the NEB, the Newbrain, but they decided we couldn't afford it and so that was pushed out to Newbury. I don't know what has happened to it, but it has not seen the light of day.

"It was about the same time that Chris Curry, who had been running Science of Cambridge, left to start Acorn.

"We thought about making the ZX-80 in August the year before last. We needed a product and that was it. Clearly, I had anticipated the success of the ZX-80 because we ordered a 100,000 parts — somewhat unusual in the computer business.

"There are two big markets. There is the hobbyist and the man in the street. The hobbyist was a dead certainty. We knew we could sell to him because we have so much experience of it and we were offering a better product. The much less certain prospect was the man in the street. There the view was that if we offered him a computer plus a self-training book at a keen enough price he would buy by mail order — which, of course, he has.

"As to what type of people have bought them, there is a reasonably broad spectrum. We have a higher



'What the BBC is doing, it is doing badly'

percentages from papers like the *Observer* and the *Sunday Times* but higher numbers, because of higher circulation, from papers like the *Sun* and so on. The largest age group is about 30. People tend to spend an unbelievable number of hours with them when they receive them. It is surprising how people have actually used them to serious purpose. The ZX-80 was very much a stepping stone to the ZX-81. I think the ZX-81 has a long life. Next time we release a machine, it will not be a replacement but another kind of machine.

"There is a point where there is no saving to be made: in going from the ZX-80 to the ZX-81, we have gone from 22 chips down to four. There isn't much prospect of having even fewer chips because you need some capability to update and so on. By trying to put it all on one chip, you rule out that possibility. What I do see is that more functions will be available".

"There has been a certain amount of controversy about the decision of the BBC to have a microcomputer built under contract to promote with its computer-literacy scheme which starts on BBC TV next January.

"I have no objection to the contract going to Acorn", says Sinclair. "We have an argument with the BBC on several grounds. First the way in which it conducted the affair; secondly, selling a product anyway and thirdly, ignoring the industry.

"When you have a company like ours, which is easily dominating the whole of Europe in personal computers, we believe we have done a very important job in popularising computers. It is a real disappointment to have your own national broadcasting corporation completely ignore you.

"What the BBC is doing, it is doing badly and it is damaging the whole progress of computers in this country. We have put a new version of Basic into our machines. It has been highly praised in the U.K. and abroad, because of its editing facilities. We developed into it features such as single-keyword entry. None of that is in the BBC version.

"Even if the BBC uses another computer, it is silly to ignore progress. What it has offered is Microsoft Basic. If we had wanted to use Microsoftware, we could have bought it off the shelf for $10,000 and saved ourselves a small fortune — really it is disheartening".

Sinclair is also dismissive about Government plans to promote computing. "The Government has it so wrong. Frankly, they are so bad at it, it would be better if they left it alone. Fine, they should be doing things for the computer market, but this recent Department of Industry scheme is so peculiar. We were not even talked to.

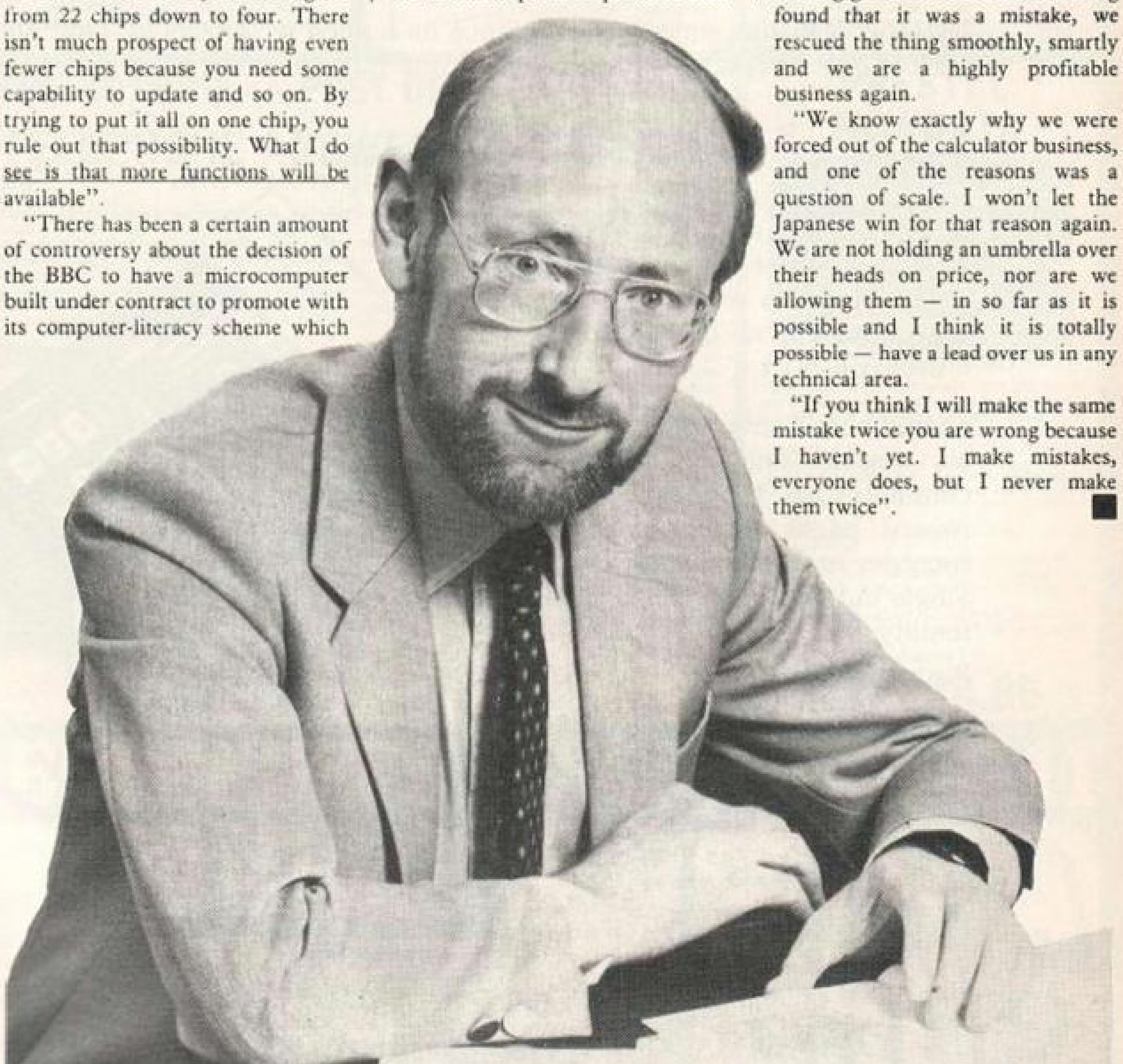
"We went to them when they told us about the scheme and asked what we had done wrong. They said you need CCTA approval. We went to the CCTA and they said it is not our job to approve machines. The BBC machine does not have CCTA approval nor could it obtain CCTA for it. The truth of the matter was that the Department of Industry had no idea whatsoever.

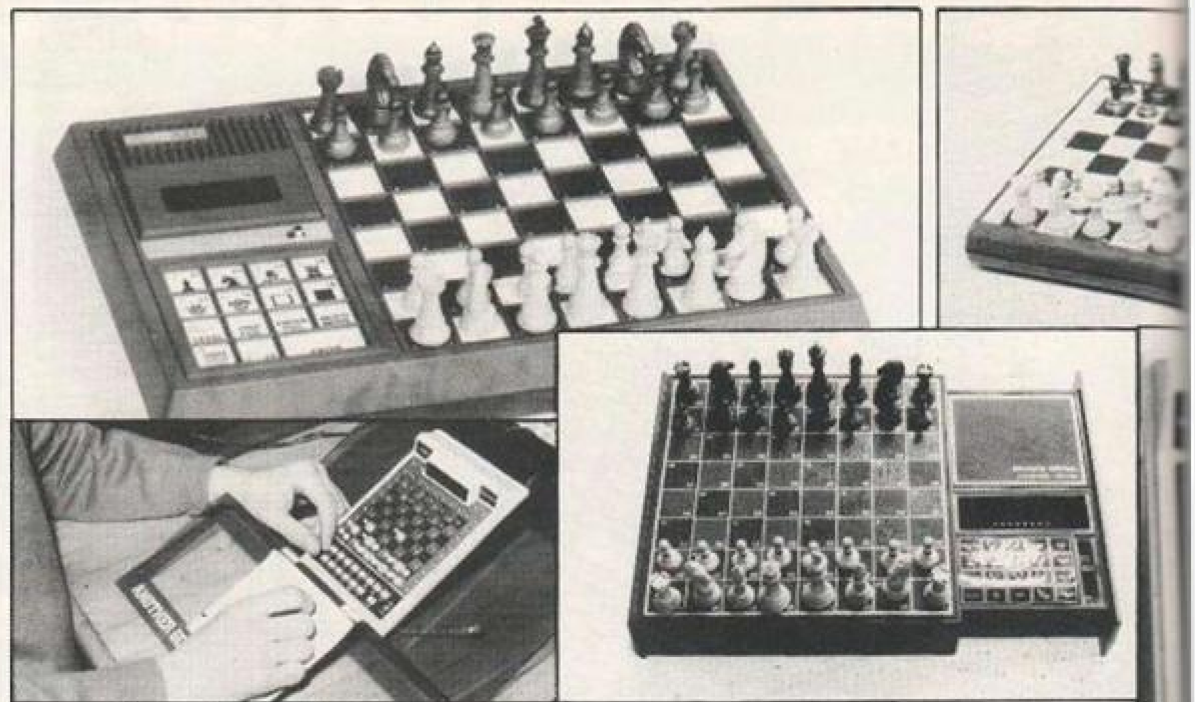
"What is vital is that we improve the way of funding businesses. The changes I have seen while I have been in business have been striking. We must be bolder. Until Johnny goes to the careers master and the careers master says: Are you considering becoming an entrepreneur? we have not really won".

Nor does Sinclair accept that his record of eventual failures might have deterred the BBC and the Government from becoming involved: "That's not the record really. We certainly got into financial difficulties over the Black Watch and we went to the NEB — but that was after 15 years of unbroken commercial success. Having gone to the NEB and having found that it was a mistake, we rescued the thing smoothly, smartly and we are a highly profitable business again.

"We know exactly why we were forced out of the calculator business, and one of the reasons was a question of scale. I won't let the Japanese win for that reason again. We are not holding an umbrella over their heads on price, nor are we allowing them — in so far as it is possible and I think it is totally possible — have a lead over us in any technical area.

"If you think I will make the same mistake twice you are wrong because I haven't yet. I make mistakes, everyone does, but I never make them twice". ■







SURVEY
CHESS GAMES

Can chess machines provide such good games as human adversaries? Before you make any opening moves to buy one, John White runs through manufacturers' gambits in his evaluation of the range of microchess opponents.

THERE ARE far more casual chess players than serious ones. Britain's chess clubs can muster only a few thousand players whereas the BBC's *Master Game* claims an estimated audience of some 1½ million viewers. The distinction between the casual and serious chess player divides the most recently-released chess computers into two classes.

Firstly, there are the relatively-unsophisticated and inexpensive models aimed at a large market — particularly at beginners. No matter how good chess machines may become in the future, there will always be a market for those capable of providing a reasonable level of play for beginners.

Secondly, there are the well-designed, strong-playing and expensive models. To enlarge the potential market for these costly machines, manufacturers tend to keep adding gimmicks to encourage well-heeled, lesser players to buy them. Sadly, there have been no significant improvements in the chess-playing standards of the better machines during the last year.

A welcome development has been the increase in the number of chess programs available in software — tape, disc or ROM — for domestic microcomputers. Outstanding among these is the new Sargon II which is available for Tandy TRS-80, Video Genie and Apple. The older Sargon I can still be bought for TRS-80 and Nascom.

The famous Microchess is also now available for Pet and Apple in the 2.0 version, and this 8K program now includes a few book openings. Another excellent introduction is Gambiet 80, a 10K program for TRS-80 which, at £20, is both fast and very strong — it did well in the 1981 Microcomputer Chess Championship.

Other announcements include "Chess", £8.50, Kansas City Software, which is claimed to be faster and stronger than Microchess, for TRS-80 and Video Genie, and "Chess" for the Sharp MZ-80 — a program best suited to beginners.

My main criticism of all these programs is their often-incomprehensible graphics. I should like to see only moves displayed and the memory saved used to improve the program or to add more book openings.

These days, all the programs in software or in machines offer castling, *en passant*, pawn promotion, the option of playing black or white and the ability to establish a position and watch the computer react.

Yet, not all possess the important facility of random selection between moves of equal merit, a feature which makes each game different, and not all possess book-opening knowledge which is essential against some openings.

Manufacturers place increasing reliance on games between two chess computers to establish the superiority of one type. As long as the machines are not capable of inventive play — that is, as long as they continue to make their moves by re-shuffling their pieces into "better" positions according to their programs — these results will not be of relevance to the ordinary chess player.

The only true test of the machines' strength, at present, is its play against an inventive human opponent. I have generally ignored all levels or response times which exceed an average of five minutes since this represents the absolute maximum that any human should be expected to wait for a move — tournament standard is 2½ minutes a move.

The well-tried Chess Challenger 7 and Voice Challenger — which can now be found in some stationers' branches — have been upgraded by the addition of a sensory board to give respectively the Chess Challenger 8 and Sensory Voice Challenger.

The sensory boards register movement of the pieces by pressure and by lights. Thus, to move your piece from d2 to d4 requires you to press the edge of the piece firmly on square d2, a small light glows, and then on d4. Both lights go out and the computer-thinking light goes on.

The computer then lights up the square of the piece it wishes to move. You press down on that square, causing the square to which the piece is to be moved to light. Pressing the piece on this square causes both lights to go out. The sensory board is very effective and a definite improvement on the original models.

The Sensory 8 has an extra intermediate level compared to the older Challenger 7 which usefully fills a gap between a comparatively weak, but fast level and a stronger, but too-slow level. It is rumoured that the 8's program is slightly stronger than the 7's, but I have not been able to confirm this. The Sensory 8 also possesses a useful library of book openings in its 32K ROM.

The Sensory Voice Challenger offers the voice of its predecessor, but it is now possible to turn the voice down, as well as off altogether. In addition, it can take a player stepwise through 64 pre-programmed games played by grandmasters.

After each move shown by the computer on behalf of the grandmaster, the player is asked for his move. The computer tells you whether you were right or wrong — one hopes that the grandmaster, whom the player is trying to emulate, is always right. These two features are of doubtful value — unless you are blind — and the voice adds considerably to the cost. I wonder how long Fidelity will persevere with it, in the face of almost universal criticism?

Much more useful is a clock display, which is not available on the Sensory 8, that shows the time elapsed for each player and a comprehensive book opening library of 64 openings of widely-variable depth.

Both of the Sensory Challengers offer a random choice between moves which are assessed of near-equal strength, and both can be operated by mains or batteries. Note, however, that at the highest levels, batteries may run out before a game is complete. Printers will also be available to provide permanent records of the game, at a cost of around £170.

The Sensory Voice Challenger is one of the strongest machines on the U.K. market at £280. The Sensory 8, at £130, is almost as strong and represents outstanding value for money — strongly recommended.

The older Challenger 7 and Voice Challenger are still available at reduced prices, respectively £90 and £220. A new model, partly-designed by the Spracklens of Sargon fame, is in the pipeline and will be launched when stocks of the Z-80 microprocessors are exhausted.

The first British chess computer is Intel-



ligent Chess, marketed by Optim games and part-designed by International Master Levy and World Chess Federation (West Europe Section) President, O'Connell. Considerable attention has been paid to user facilities. No chess board is supplied, but the game is displayed on the user's TV set — in colour, if you have a colour set.

A cassette deck is built-in enabling games to be preserved for posterity together with a voice-over commentary for which a microphone is also provided. Alternatively, you can buy cassettes which teach the use of the machine — luckily there is also a manual to tell you how to use the cassette — and to teach the game or the openings, or demonstrate games by famous grandmasters.

The computer has 13 playing levels, with a further four levels for analysis. The setting of the level affects the time spent on a move. A timer is set which decreases to zero at which point the move is displayed. Meanwhile, the machine constantly flashes the move it is considering.

This means that the machine spends the same time thinking regardless of the complexity of the game — an advantage in the end-game where moves can be examined in greater depth, but not so in mid-game.

Many other chess machines share this method of setting levels, but notable exceptions are the Chess Challenger series and the Sargon series of programs which all examine moves to a fixed depth, regardless of the state of play, unless captures are involved.

Intelligent Chess is based on the 6502 microprocessor and provides 64K ROM and 16K RAM. The 16K RAM is needed for storage of 120 positions through which it is possible to back-step in case your blunder was not only fatal, but also very subtle.

The machine offers a widely-varied and interesting selection of book openings and as well as the usual chess facilities, can also detect draws by repetition of moves or by playing 50 moves without a piece being taken or a pawn moved: the Super System III is the only other machine which does this.

There is no random facility for selection between moves of equal merit; instead, the players can ask the machine to display its next best move, or the next, or the next, and then play on from there.

The display on a colour television is superb, with black and white pieces on sky-blue and pale-green squares — very appealing. When making a move, the piece being moved flashes to and from the target square until enter is pressed. The same occurs when the machine makes its reply.

This to-and-fro occurs three times, presumably to draw the user's attention, but I found it rather tiresome when the computer was making its own move. The board can also be used as a display for a game between two human players, where no illegal moves will be accepted.

At a price of £300, Intelligent Chess must stand comparison with the best of the other available machines. I have timed the following levels: level 3, one minute; level 6, three minutes; level 9, six minutes, so that it is no faster than most of the competition.

The standard of play is very good, but not, I feel, quite as strong as the Sargon 2.5 or any of the Chess Challenger series with their equal response times up to five minutes. Since it is the most versatile of these machines, I suspect that it may prove to be the best-seller.

Opinions vary as to the standard of play of the Super System III — £155 for main unit; £107 for small black/white board display, £105 for printer. It offers no book openings and thus is muddled by my own favourite opening, the Queen's Gambit — d2-d4; d7-d5; c2-c4 — where it takes a deep search to find that if you accept the gambit, you must not then defend the capture at all costs.

The machine also lacks a random facility to choose between moves of equal merit. However, certain features indicate that a great deal of thought has been put into the machine. For example, it is capable of making arrangements to double its rooks along a file and, after castling on the queen's side, it will often take a further move to tuck its king further behind its pawn screen — a pleasing touch.

Overall, Super System III is clearly one of the better machines, especially at longer response times — good for postal chess — and many club players love it. Personally, I prefer the Sensory 8 which has a clear advantage in the opening because of its library of book openings. I consider the strength of SSIII's play in the middle game to be similar to that of Intelligent Chess — perhaps not surprising, since Philidor Software had a hand in the design of both.

The Sargon 2.5 chess machine, £280, remains the strongest and fastest on the domestic market. It is being superseded by an improved chess cartridge called Morphy at a price of £80 which is discounted to previous owners. Because of Morphy, the Sargon 2.5 chess machine can, therefore, be obtained from some sources at about £200.

The concept is modular: the chess program is on a cartridge which can be replaced by improved versions as they become available — or by other games cartridges — while keeping the main unit.

With a rechargeable battery pack, random selection between moves of equal merit and a reasonable selection of book openings, this machine unquestionably has all that the serious chess player could ask for. Special mention must be made of the unit's ability to retain an uncompleted game in its memory even after switch-off, ready to start again at a more convenient time.

Although the program, which is packed into only 8K ROM and 1K RAM, is not markedly superior to other good machines in mid-game, and its store of book openings is inferior to, say, the Sensory Voice Challenger's, its speed of response is outstanding and its end-game is superior to that of any other commercially-available machine. To do

(continued on page 27)

Beginners' games and prices

Tandy Chess Machine, £70: eight levels, no book openings, no random responses. Designed to be portable.
Chess Traveller, £60: seven levels, book openings, random responses. Designed to be portable.
Boris Diploma, £70: Timer set between 0 seconds and 99 hours. Random responses. Designed to be portable.
Delta-1, £40: Timer set between 0 seconds and 99 hours. No book openings or random responses.
Texas Instruments Videochess, £45 ROM for TI-99/4: three levels, three styles of play at each level. Full-colour display.

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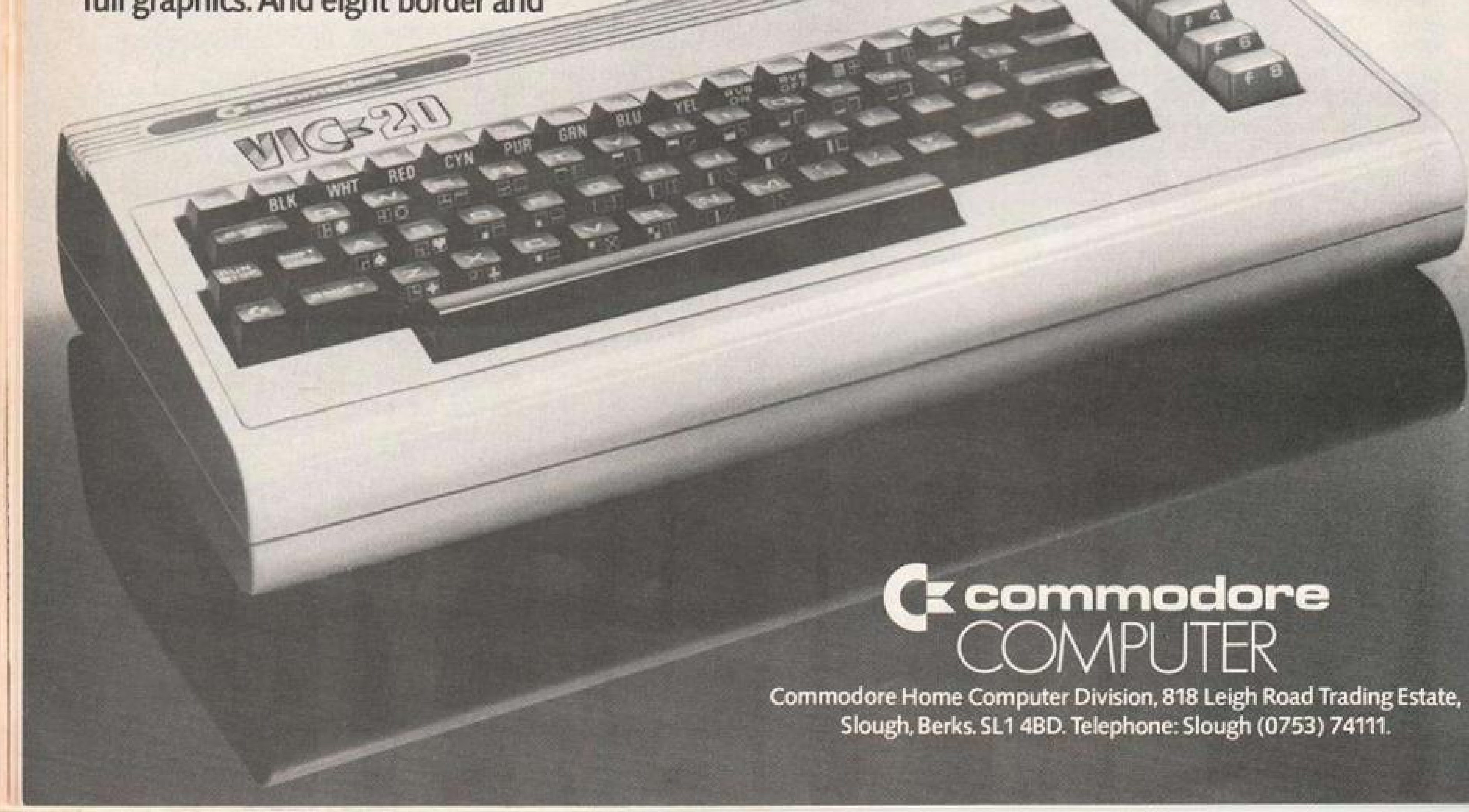
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(continued from page 25)
this, its evaluation function must be very well designed. Normally, the end-game is the weakest part of any chess computer's game.

The identical 2.5 program is also available in the Auto-Response Board which additionally has a touch-sensitive board for moving the pieces, similar to that described for the Sensory Challengers. The Auto Response Board also possesses a slightly superior library of book openings. Beautifully finished in wood, this machine is the nearest yet to perfection — at a price — £700.

Sargon 2.5, like the older Boris which has the same manufacturer, occasionally flashes one of about 60 messages across its display, related to the state of the game. These add nothing to its chess-playing ability and the Auto-Response Board does without them. After a time they become boring, but it still amuses me to see the machine plead "I need help" when it evaluates its position as desperate.

Sargon 2.4 would be my recommendation for the serious player. However, club players should note that my estimate of its playing strength falls below the distributor's claims. I cannot accept that its mid-game play, at top level — level 4 — is equivalent to a player rated at BCF 170.

The machine scored BCF 139 for complete games in the recent *Evening Standard* Chess Congress, but London players are notoriously over-rated and I would assess its rating overall at about 130 — which is also the equivalent of a rating which it achieved recently in the U.S.

The machines which follow are all best suited to beginners, and would be unlikely to seriously trouble most club players.

Tandy's chess machine is custom-made in Hong Kong, and is clearly designed as a travelling companion with battery operation — mains is an optional extra — and miniature pegs for playing pieces. At £70, it provides eight levels of play from two seconds to three hours, no book openings and no random responses. Changing levels alter the depth of search and not the time allocated for thinking.

The Chess Traveller, £60, bears a superficial resemblance to the Tandy machine, and is again clearly designed as a travelling companion with battery operation and small pegs as playing pieces. There are seven levels of play and the machine also offers some book openings and random selection between moves — the cheapest in this survey to do so.

The Boris Diplomat contains the same program as the original Boris which is now withdrawn. The original Boris was outdated and overpriced by today's standards at its former cost of £180. The Diplomat is better value at £70 and is again designed as a travelling companion with mains or battery operation and small pegs for playing pieces. The level of play is altered by setting a timer — up to 99 hours — and the machine also offers random selection between moves.

The Delta-1, £40, is marketed by Sci-SysW as a inexpensive alternative to the company's more prestigious Super Sytem III machine. The level of play is altered by setting a timer, and the move being considered is constantly displayed, as is quite usual for this type. There are no book openings and no random responses.

Good value at the price for beginners and very attractively finished, but the manufacturer should do something about the weak response to an opening of e2-e4. The machine replies d7-d5 at all time settings up to five minutes.

Texas Instrument's Videochess owes a great deal to the influence of British Master Levy, who served as a consultant. It is available only in ROM for the TI-99/4 home computer, at £45. The board is displayed on the computer's monitor in full colour and the result is very pleasing.

There are three levels of play, and each level can be set to play in an aggressive, passive or normal mode. Unfortunately, it is rather hard to find in the shops now since the TI-99/4 has not been an unequivocal success and, as I write, several retailers are destocking at cut prices.

Since the program was written for the Texas Instruments microprocessor, the RMS-9900, I fear that Videochess may disappear. This would be a pity, since it is one of the better chess programs available in software.

The Atari chess cartridge at £45 is available for the Atari Videogames System. The display is lost while the machine "thinks" and the graphics are almost incomprehensible. There are no book openings.

Finally, readers considering buying any chess machine will be pleased to hear of their reliabiiity. None of the machines I have tested has been defective — some straight out of the manufacturer's original packing — no retailer I have spoken to has admitted to having received a single unit back for repair, and my faithful Challenger 7 has taken a tremendous keyboard battering without any defects at all.

CONCLUSIONS

- The Sargon 2.5 remains the strongest and fastest chess computer. The best buy for serious players, but the price may be somewhat high.
- Optim's Intelligent Chess, £300, has a superb colour display with many useful user features, including taped tutorials on how to play the game. The standard of chess is good, too — but not as good as Sargon.
- The Super System III is still one of the better chess machines at £155. Forget the costly LCD board and printer — a chess board and paper and pen are much less expensive.
- The Sensory 8 Fidelity is excellent value at £130 — or without the sensory board as the Challenger 7 at £85 — with a strong program.
- The Auto-Response Board at £700 must be the best chess computer available, but the price is beyond most of us and represents poor value in pure chess terms.
- The Sargon program is available in its original version for TRS-80 and Nascom, and in the II version for TRS-80 and Apple microcomputers, at around £15-£30 depending on documentation and supplier. The best program in software of those surveyed.

Grandmaster or novice?

John White presents a chess-rating analysis program in Basic. It has been designed to help you maximise your rating as a player.

As REGULAR CHESS players will know, the British Chess Federation organises a rating system for its league players over a season. The principle is that if you beat an opponent in the league, you take his rating and add 50. If you lose, you take his rating and subtract 50. If you draw, the rating alone is taken.

The results obtained in this way over the season are averaged to give your rating for the new season. Similarly, your opponents take account of your rating and their results against you when determining their own new rating.

Ratings vary from 80 — knows the moves only — to more than 200 — national/international standard. An average club player would be rated at about 130-160.

It is at once evident that it is theoretically possible to devise a strategy which would raise your rating, allowing for the fact that the better your opponent, the more likely you are to lose, while the worse he is, the more likely you are to win.

To take a trivial example, if a player rated at 100 plays a national player with a rating of 200 10 times, then, even though he will lose every game, his new rating will be

$$\frac{(200 - 50) \times 10}{10} = 150$$

On the other hand, the good player's new rating will now be

$$\frac{(100 + 50) \times 10}{10} = 150$$

So, both players will appear of equal strength at the end of the season. Clearly, the good player is well advised to avoid an opponent of such low rating.

In practice, the teams in the leagues are organised in decreasing order of rating, so that players of more nearly equal strength play each other. The program shown in listing 1 explores the possibility of evolving a strategy of selecting your opponent, if possible, to maximise your own rating.

The outcome of a game involves a random element RND(1) = 0.0 to 0.999 which is biased according to the difference in rating between yourself and your opponent. The bias is positive if you have the higher rating, negative if you have the lower. (continued on next page)

(continued from previous page)

If random element + bias is greater than 0.6, you win. If less than 0.4, you lose, otherwise the game is a draw. Thus for equally-rated players, with no applied bias, the chance is 40 percent for a win, 40 percent for a defeat and 20 percent for a draw for each player.

Ten games are played by your opponent at each level between ratings of 100 and 180, after you have entered your own rating if you do not have a rating, guess at 130 if you take chess reasonably seriously.

The crucial line is line 70, where the probability of winning or losing a game is considered to be directly proportional to the difference in rating, leading to the straight line graph of bias plotted against rating difference illustrated in figure 1. This is obviously an algorithm which can be disputed, and readers might also like to substitute line 70 by the following:

```
70 Z(J) = (R − X * 10)∧3/100000 + RND(1)
```

This provides the curved-line graph shown in figure 1, which intuitively seems to be more plausible: little effect when your opponent's rating is close to yours, dramatically increasing as the difference widens.

The first version of line 70 is technically correct since ELO ratings which are related to BCF ratings by the simple formula

ELO = (BCF * 8) + 600

are calculated so as to be linearly related to chess ability.

The program is written in Microsoft Basic and should not present any problems. Note that your opponent's rating is given throughout as "10 * X", instead of simply as "X". This is to save memory since otherwise the Dim statement of line 10 would require a total of 400 memory locations, of which only 18 would be used.

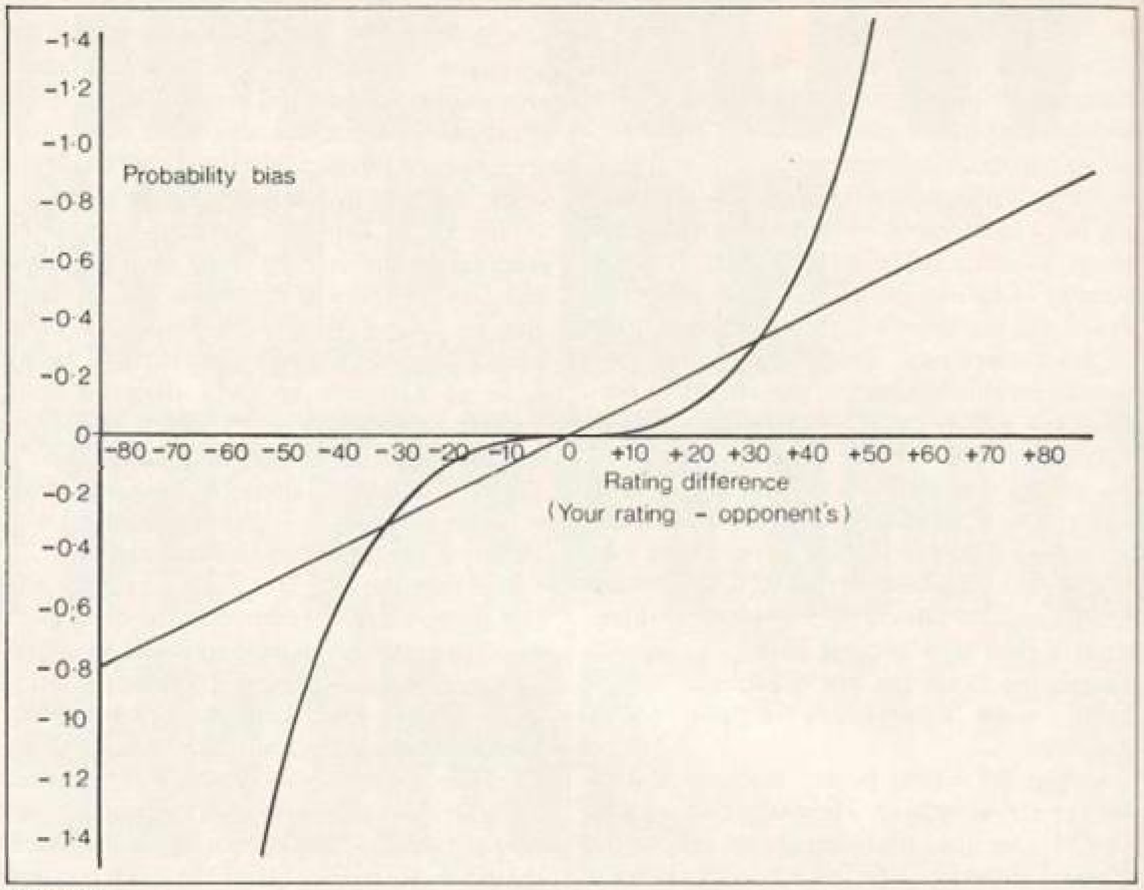


Figure 1.

Since the program is a continuous loop, it will be necessary to exit with CTRL/C or a similar command. I believe that constantly having to answer the question: "Do you want to try again"? at the end of short program runs is pointless and time-wasting.

You should run through the program repeatedly to see what pattern emerges, and the results from each run should be compared to the previous one to test whether the results are reproducible.

Club players with whom I have spoken all seem to favour different methods to beat "the system". How do your results compare to the following, mutually-incompatible statements.

- "To raise your rating, it is best to keep playing opponents who are slightly better".
- "To raise your rating you should only play opponents much worse than yourself".

Finally, officials of the British Chess Federation can relax — no simple means of cheating is accessible with this program. May I remind readers that the best way to improve your chess play if not your rating is to keep playing a slightly superior opponent. ■

Listing 1.

```
5 REM,Chess Rating by J.F. White
10 DIM A(20),R(20)
20 INPUT "YOUR RATING =";R
30          R3 = 0
35 PRINT "Opp R   W   D   L   Final R"
40 FOR X = 10 TO 18
45 R(X) = 0: A(X) = 0
50 W=0: D=0 : L=0
60 FOR J = 1 TO 10
70 Z(J) = (R-X*10)/100 + RND(1)
80 IF Z(J) > 0.6 THEN W=W+1: GOTO 110
90 IF Z(J) < 0.4 THEN L=L+1: GOTO 110
100 D=D+1
110 NEXT J
120 R(X)=(100*X+50*W-50*L)/10
130 IF R(X) = R3 THEN A(X) = X*10
140 IF R(X) > R3 THEN R3 = R(X):A(X) = X*10
150 PRINT X*10;TAB(6);W;TAB(9);D;TAB(12);L;TAB(15);R(X)
160 NEXT X
170 PRINT "Your best new rating was";R3;"against opponent(s) "
180 FOR P = 10 TO 18
190 IF R(P) = R3 THEN PRINT A(P)
200 NEXT P
210 GOTO 20
220 END
```

Note: Varibles shown on screen:
Opp R = opponent's rating
Final R = your final rating playing against opponent's rating
W = number of wins by you against opponent's rating
D = number of draws by you against opponent's rating
L = number of defeats by you against opponents's rating

ORACLE OF CHANGE – I CHING

BY JOHN ALDRED



The *I Ching*, or *Book of Changes*, is an ancient work on divination in which is distilled much of the wisdom of a culture measurably older than our Judaeo-Christian one. John Aldred offers an easily-translatable Sharp MZ-80K program which augurs well for the future of the more unusual micro applications.

BOTH OF THE great Chinese religions, Confucianism and Taoism, have drawn heavily on ideas contained in the *I Ching*. It is proper, then, to treat this volume with a substantial measure of respect. It is not a game: the work only begins when you have thrown your hexagram and strive to understand the meaning of a text what may seem obscure and difficult, and to relate it to your own life.

Some observers recommend meditation beforehand, to clear the mind of all that is trivial or extraneous; this may not be necessary, but it is important not to treat the program as an interlude in a *Space Invaders* session.

Originally, the divination was performed with the aid of 50 yarrow stalks, which are thrown in such a way as to form an apparently random pattern of six lines. The symbol built up in this way is then interpreted by a text. To Western minds, this may seem bizarre or uncouth: what significance can a randomly-generated symbol have? It is in this area that the *Book of Changes* demonstrates its great difference from Western methods of divination.

The argument is that the unconscious in the mind of the seeker is released and interpreted through the fall of the stalks. If you believe in the system, the parameters which form the symbol will correspond more closely to the situation of your life on which you need advice. Put in a quasi-scientific form, you might say that the fall of the stalks was determined by telekinesis. After all, it is you who throw the stalks.

The throwing of the stalks is a complicated procedure — though mathematicians might find the account contained in the Wilhelm/Baynes translation, published by Routledge, Kegan and Paul, especially stimulating — and most seekers in the West use the three-coin method. This consists of throwing three coins and interpreting the fall in terms of the four possibilities.

This is done six times and forms a hexagram which may or may not contain moving lines — lines which change to their opposites and which modify the first hexagram to form a second, subsidiary hexagram with a different interpretation from the first.

Purists may be interested to examine in depth the randomising aspect of this program. The whole point of the *I Ching* is that the symbol which is generated randomly is in fact influenced by the throws — the agency — of the thrower. If there is no genuine randomness — that is, if the computer itself rather than the subject is making the "decisions" with respect to each throw of the coins, it may invalidate the real nature of the oracle. Be that as it may, there is a tremendous wealth of wisdom in the *I Ching*: if the program serves to initiate potential readers, it is valuable indeed.

To use the program, formulate a suitable question and a hexagram is constructed, the correct interpretation of which provides the answer to the question. A hexagram is built from the bottom upwards. Each line depends on the result of tossing three coins. A head scores three and a tail scores two. The four possible results are:

Three tails	2+2+2=6	Old Yin	—X—
One head two tails	3+2+2=7	Yang	———
Two heads one tail	3+3+2=8	Yin	— —
Three heads	3+3+3=9	Old Yang	—O—

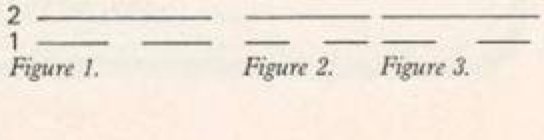


Figure 1. *Figure 2.* *Figure 3.*



For example, after six throws, you might have the situation shown in figure 1. Lines 3 and 6 are change lines and are more significant. The hexagram is identified by ignoring the X or O in change lines for the moment — figure 2. A second, less important hexagram, giving a broader answer to the question, is formed by converting each change line to its opposite — figure 3. Of course, if the tossing of the coins produces no change lines, only one hexagram is produced.

There are 64 possible hexagrams and 4,096 different combinations of lines. To interpret the hexagrams you need a book of the *I Ching*.

When the program is run, each line is built up in turn, and then the name and number and page references in the book for the hexagram are shown, along with markings for the ruling lines. ● denotes a governing ruler and ◆ denotes a constituting ruler. The names of the constituent trigrams — top and bottom three lines only. If there is a change hexagram then this is also shown with corresponding information.

```
1 REM MZ-80K I CHING  (Approx 9K RAM)
2 PRINT"▩":GOTO20
3 PRINTLEFT$(D$,D)::RETURN
6 GETE$:IFE$=""THEN6
7 RETURN
8 FORK=1TO250+W:NEXT:RETURN
20 D$="▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯":A$="▓▓▓▓▓▓▓":U$="────────────────────────────"
30 DIMA(64,1),A$(64,2),T$(1),L$(3),VM(6),VC(6),UL(8,8),TR$(8),TN$(8),SP$(1)
31 DIMX$(3)

34 X$(0)="┌────┬──┬──┬──┬──┬──┬──┐"
35 X$(1)="│    │  │  │  │  │  │  │"
36 X$(2)="├────┼──┼──┼──┼──┼──┼──┤"
37 X$(3)="└────┴──┴──┴──┴──┴──┴──┘"

40 T$(0)="Tails":T$(1)="Heads"
50 L$(0)=" "+CHR$(246)+" ":L$(1)="▓▓▓":L$(2)="   ":L$(3)="▓□▓"
55 FORJ=0TO3:L$(J)=A$+L$(J)+A$:NEXT
60 DATA1,34,5,26,11,9,14,43,25,51,3,27,24,42,21,17,6,40,29,4,7,59,64,47,33,62
61 DATA39,52,15,53,56,31,12,16,8,23,2,20,35,45,44,32,48,18,46,57,50,28,13,55
62 DATA63,22,36,37,30,49,10,54,60,41,19,61,38,58
63 FORJ=1TO8:FORK=1TO8:READA:UL(K,J)=A:NEXTK,J
70 TR$(1)="111":TR$(2)="122":TR$(3)="212":TR$(4)="221":TR$(5)="222"
75 TR$(6)="211":TR$(7)="121":TR$(8)="112"
80 TN$(1)="Ch'ien":TN$(2)=" Chen":TN$(3)=" K'an":TN$(4)=" Ken":TN$(5)=" K'un"
85 TN$(6)=" Sun":TN$(7)=" Li":TN$(8)=" Tui"
90 SP$(0)="The Gentle, Wind":SP$(1)="The Joyous, Lake"
101 DATA5,Ch'ien,3,369,The Creative
102 DATA2,K'un,11,385,The Receptive
103 DATA15,Chun,16,398,Difficulty at* the Beginning
104 DATA25,Meng,20,405,Youthful Folly
105 DATA5,Hsu,24,410,Waiting
106 DATA5,Sung,28,415,Conflict
107 DATA25,Shih,31,420,The Army
108 DATA5,Pi,35,425,Holding Together
109 DATAD5,Hsiaou Ch'u,40,430,The Taming Power*of the Small
110 DATAC5,Lü,44,435,Treading
111 DATA26,T'ai,48,440,Peace
112 DATAB5,P'i,52,446,Standstill
113 DATA25,T'ung Jen,56,451,Fellowship*with Men
114 DATA5,Ta Yu,59,456,Possession in* Great Measure
115 DATA3,Ch'ien,63,461,Modesty
116 DATA4,Yü,67,466,Enthusiasm
117 DATA15,Sui,71,471,Following
118 DATA5,Ku,75,476,Work on What Has*Been Spoiled
119 DATA12,Lin,78,481,Approach
120 DATA56,Kuan,82,485,Contemplation
121 DATA5,Shih Ho,86,489,Biting Through

122 DATA26,Pi,90,494,Grace
123 DATA6,Po,93,500,Splitting Apart
124 DATA1,Fu,97,504,Return
125 DATA15,Wu Wang,100,509,Innocence
126 DATA56,Ta Ch'u,103,514,The Taming Power*of the Great
127 DATA56,I,107,519,The Corners* of the Mouth
128 DATA24,Ta Kuo,111,524,Preponderance*of the Great
129 DATA25,K'an,114,530,The Abysmal
130 DATA25,Li,118,535,The Clinging,*Fire
131 DATA45,Hsien,122,540,Influence
132 DATA2,Heng,126,545,Duration
133 DATAAB5,Tun,129,550,Retreat
134 DATA4,Ta Chuang,133,555,The Power of* the Great
135 DATA5,Chin,136,559,Progress
136 DATA25F,Ming I,139,564,Darkening of* the Light
137 DATA25,Chia Jen,143,569,The Family
138 DATA25,K'uei,147,573,Opposition
139 DATA5,Chien,151,579,Obstruction
140 DATA25,Hsieh,154,584,Deliverance
141 DATAC5F,Sun,158,589,Decrease
142 DATAA2D5,I,162,595,Increase
143 DATA5F,Kuai,166,602,Breakthrough
144 DATAA25,Kou,170,608,Coming to Meet
145 DATA45,Ts'ui,174,614,Gathering*Together
146 DATAA5,Sheng,178,619,Pushing Upward
147 DATA25,K'un,181,623,Oppression
148 DATA5,Ching,185,629,The Well
149 DATA5,Ko,189,635,Revolution
150 DATA56,Ting,193,641,The Cauldron
151 DATA1,Chen,197,647,The Arousing,*Thunder
152 DATA6,Ken,200,652,Keeping Still,*Mountain
153 DATA25,Chien,204,657,Development
154 DATAC5F,Kuei Mei,208,663,The Marrying*Maiden
155 DATA5,Feng,213,669,Abundance
156 DATA5,Lü,216,674,The Wanderer
157 DATAAD5,Sun,220,679,SP
158 DATA2C5F,Tui,223,685,SP
159 DATABD5,Huan,227,689,Dispersion
160 DATA5,Chieh,231,694,Limitation
161 DATACD5,Chung Fu,235,698,Inner Truth
162 DATA25,Hsiao Kuo,239,703,Preponderance*of the Small
163 DATA2,Chi Chi,244,709,After Completion
164 DATA5,Wei Chi,248,714,Before Completion
165 FORJ=1TO64:READG$,A$,B,C,F$:A$(J,2)=G$:A$(J,0)=A$:A(J,0)=B:A(J,1)=C
166 A$(J,1)=F$:NEXT
```

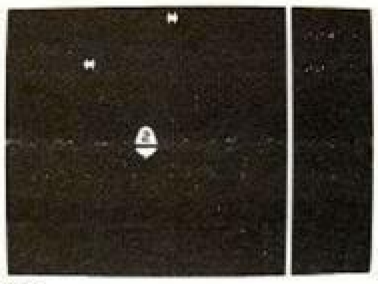
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```
200 CF=0:GOSUB500:FORL=1TO6:S=0:POKE53860+L*4,107:FORJ=1TO3:GOSUB6
205 D=17+J:IFJ=1THEND=21
210 GOSUB3:PRINTSPC(6):Z=INT(RND(1)*2)+2:D=18+J:GOSUB3:PRINT"";T$(Z-2);
220 PRINTTAB(12+L*4);LEFT$(T$(Z-2),1);:S=S+Z:NEXTJ:D=23:GOSUB3
230 PRINTTAB(12+L*4);STR$(S):VM(L)=S-6
240 D=15-L*2:GOSUB3:PRINTSTR$(L);" ";L$(S-6);:IF(S=6)+(S=9)
    THENPRINTSTR$(S)
250 POKE53860+L*4,120:NEXTL:W=2:GOSUB8:FORD=15TO25:GOSUB3:
    PRINTSPC(39);:NEXT
270 FORL=1TO6:VC(L)=VM(L)
280 IF(VM(L)=0)+(VM(L)=3)THENCF=1:VC(L)=1+VM(L)/3:VM(L)=2-VM(L)/3
300 NEXT:L=1:GOSUB600:LM=X:GOSUB600:UM=X:HM=UL(UM,LM)
310 L=1:GOSUB605:LC=X:GOSUB605:UC=X:HC=UL(UC,LC)
450 PRINT"▣     MAIN HEXAGRAM":PRINT"     ─────────────────"
460 T=2:H=HM:U=UM:L=LM:GOSUB700:IFCF=1THEN480
470 D=6:GOSUB3:PRINTTAB(29);"No":PRINTTAB(27);"▣Change"
475 PRINTTAB(26);"▣Hexagram":GOTO495
480 PRINT"▣";TAB(23);"CHANGE HEXAGRAM":PRINTTAB(23);"──────────────────"
485 FORL=6TO1STEP-1:D=15-L*2:GOSUB3:PRINTTAB(22);L$(VC(L)):NEXT
490 T=22:H=HC:U=UC:L=LC:GOSUB700
495 GOSUB6:PRINTD$;"  Do you want to cast another hexagram?";
496 GOSUB6:IFE$="Y"THENPRINT"▣":GOTO200
497 IFE$="N"THENPRINT"▣":END
498 GOTO496
500 D=16:GOSUB3:FORJ=1TO9:PRINTTAB(7);X$(VAL(MID$("012111213",
    J,1))):NEXT
530 D=17:GOSUB3:PRINTTAB(8);"Line▣▣▣▣▣▣";:FORA=1TO3:PRINT"Toss"
    ;A;"▣▣▣▣▣▣▣";
540 NEXT:PRINT"▣Score":FORA=1TO6:POKE53900+A*4,32+A:NEXT:D=25:GOSUB3
550 PRINTTAB(12);"(Heads = 3  Tails = 2)";
560 D=15:GOSUB3:PRINTTAB(10);"Hit any key to toss a coin":RETURN
600 A$="":FORJ=LTOL+2:A$=A$+STR$(VM(J)):NEXT:GOTO609
605 A$="":FORJ=LTOL+2:A$=A$+STR$(VC(J)):NEXT
609 L=4:X=1
610 IFA$=TR$(X)THENRETURN
620 X=X+1:GOTO610
700 FORA=1TOLEN(A$(H,2)):A$="●":B=ASC(MID$(A$(H,2),A,1))
702 IFB>54THENA$="◆":B=B-16
705 D=111-2*B:GOSUB3:PRINTTAB(T-1);A$:NEXT
710 D=15:GOSUB3:A=(1+LOG(H)+LEN(A$(H,0)))/2:B=A:IFH=9THENA=6
720 PRINTTAB(T+6-A);"No.";H;":  ";A$(H,0):D=16:GOSUB3
730 PRINTTAB(T+6-A);LEFT$(U$,6+B*2)
735 D=17:GOSUB3:IFLEN(A$(H,1))>17THENA=10:GOTO740
736 IFA$(H,1)="SP"THENA$(H,1)=SP$(H-57)
737 AT=8:IFH=10THENAT=9
738 PRINTTAB(T+AT-(1+LEN(A$(H,1)))/2);"(";A$(H,1);")":GOTO750
740 IFMID$(A$(H,1),A,1)="*"THEN742
741 A=A+1:GOTO740
742 A$=LEFT$(A$(H,1),A-1)
743 IFMID$(A$(H,1),A-1,1)="."THENA$=LEFT$(A$(H,1),A-2)+","
744 PRINTTAB(T+8-LEN(A$)/2);"(";A$:B$=RIGHT$(A$(H,1),LEN(A$(H,1))-A)
746 D=18:GOSUB3:PRINTTAB(T+8-LEN(B$)/2);B$;")"
750 D=20:GOSUB3:PRINTTAB(T);"Book 1: Page";A(H,0)
760 PRINTTAB(T);"Book 3: Page";A(H,1):PRINTTAB(T);"▣-=≡ TRIGRAMS ≡=-"
770 A=U:B=L:GOSUB790:PRINTTAB(T);" Upper:   ";A$;TN$(U)
780 A=L:B=U:GOSUB790:PRINTTAB(T);" Lower:   ";A$;TN$(L);:RETURN
790 A$="":IFA=7THENIF(B<4)+(B=5)THENA$=" "
795 RETURN
```

■

ATOM OWNERS
LOOK OUT
There are DODGEMS about!



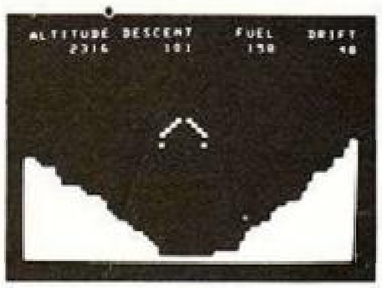
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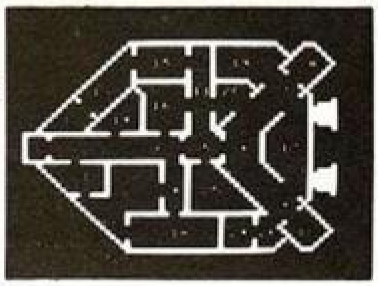
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GAMES PACK 7
Green Things An alien life-form has invaded your space-craft; discover a way of destroying it with the weapons available on the ship Program 5K, graphics 2K. COLOUR
Ballistics Take turns in firing shells at the other player, taking into account the wind and shape of the hill. Program 3K, graphics 6K, needs floating-point.
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Inside story on ZX-80/81 machine code

BY TREVOR SHARPLES

Machine code is one aspect of computer programming the ZX-80/81 manuals do not cover at all. Trevor Sharples sets out to remedy that deficiency.

IT CAN BE said that it is not necessary to understand machine code to program a computer — you can always stick to Basic. However, understanding machine code can give you a degree of flexibility which Basic will not allow. This has been proved by the range of moving-display and flicker-free machine-code programs now on the market.

Some microcomputers — the Acorn Atom and the Tangerine Micron are examples — have a facility resident in the ROM for writing machine-code programs. The ZX-80/81 do not have this facility, so it takes a great deal of work to write machine-code programs on these computers.

The central processor unit, CPU, is the brains of the computer — the ZX-80/81 CPU is the Z-80A microprocessor. The CPU obeys instructions written in the form of pairs of Hexadecimal digits — FF, C3, O7 are examples. Each pair of Hexadecimal digits has its own special meaning for the CPU.

When you write a program in Basic, the Basic interpreter, which is part of the ROM, translates the Basic language into a series of Hexadecimal instructions which the CPU can understand. This series of Hexadecimal numbers is known as machine code.

You may have heard the term assembler before. This is a stage between Basic and machine code. An assembler program provides an easy way of writing a machine-code program. Each of the Hexadecimal machine-code instructions has an assembler mnemonic — LDA 76, for example. This means LoaD the Accumulator with 76, and can also be written as 3E76 since 3E is the Hexadecimal instruction which LDA represents. The assembler will also store the machine code in certain memory locations of the computer.

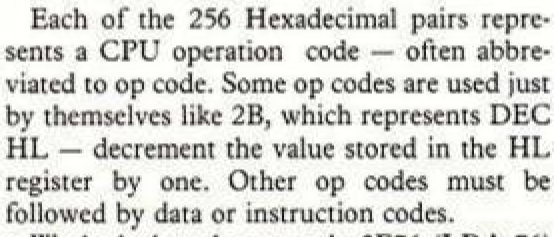
Because the ZX-80/81 do not have assembler programs written into the ROM, it becomes more difficult to write machine-code programs. You cannot use the assembler mnemonics as there is no assembler to convert them into machine code. So, if you program the ZX-80/81 in machine code, you must use the Hexadecimal pairs or their decimal equivalents directly.

These Hexadecimal pairs range from 00 to FF — 0 to 255. 255 is the largest number that can be stored in one byte. A byte is made up of eight bits — a contraction of BInary digiT, and each bit can be a one or a zero. So the range of binary numbers stored in a byte is:

00000000 to 11111111 — 0 to 255.

Each of the 256 Hexadecimal pairs represents a CPU operation code — often abbreviated to op code. Some op codes are used just by themselves like 2B, which represents DEC HL — decrement the value stored in the HL register by one. Other op codes must be followed by data or instruction codes.

We looked at the example 3E76 (LDA 76) earlier. The 3E is the op code and the 76 is the data code; load into the accumulator, 3E, the value 76—76. Address codes are similar to data codes in that they follow an op code, but



whereas data codes contain values, address codes contain the destination addresses of the Goto op codes.

For example, when the computer comes across the op code 3E — LDA — it knows that the next pair of digits is the value it loads into the acumulator. In our example the value is 76. However, 76 is also an op code, and if used in another situation it will instruct the CPU to do something rather than represent a value. This is true for all 256 Hexadecimal pairs. Depending on their position, they are either op codes, data codes or address codes. For example:

3E/76
op code/data code

A full list of op codes can be found in several books. Probably the best source is *Programming the Z-80* by Rodney Zaks which, if you are serious about machine-code programming, is a vital reference work. Other recommended books are the *Z-80 instruction handbook* and the *Z-80 software gourmet guide and cookbook,* both by Nat Wadsworth.

Learning to program in machine code is an exacting task. Once you know what you are doing it becomes reasonably easy, but you still require a good deal of concentration. This article is not meant as a complete course in machine-code programming. It is trying to show how you can use machine code on a ZX-80/81.

We have discussed the fact that the ZX-80/81 do not have the assembler facility. So how can you go about writing machine-code programs? Try this example:

```
10 POKE 17000, 201
20 PRINT USR (17000)
```

The decimal number 201 represents the Z-80A op code for return to Basic. When you Run this program, the computer Pokes 201 into address 17000. USR(n), where n is an address, calls the machine-code subroutine at that address.

In this case, the subroutine is 201 (Return), so the ZX-80/81 will print 17000 since the value in the HL register, which is the general storage area of the CPU, was unaltered. If we now do some mathematical manipulation:

```
10 POKE 17000, 43
20 POKE 17000, 201
30 PRINT USR (17000)
```

The decimal number 43 represents the Z-80A op code for "decrement HL register by one". When the machine-code subroutine is called this time, the value in the HL register is decremented by one before the Return. The ZX-80/81 will print 16999 as the answer.

You are not restricted to using 17000 as the start address of the machine-code subroutine. However, you do have to be careful where you put the machine code as it can be overwritten. That is, the ZX-80/81 does not know it is there, and unless you put the subroutine at addresses the computer is not using, there is a chance that it will be corrupted.

A good rule of thumb is to leave about 200 addresses free after the last address of the program listing — more if you are writing longer programs.

```
PRINT USR (47) + 200
```

will give you a good start address for your subroutines. Try running the last program with different start addresses.

Rather than Poke these subroutines into high vacant memory addresses, it is possible to Poke them into known and protected addresses. Add the line:

```
5 REM XXXX
```

If you change the start address of the subroutine to 16427, 16514 on a ZX-81, the computer will store the machine code in the Rem statement. This is handy as the machine code cannot be overwritten, but do not list the Rem statement. Sometimes, but not always, this will cause the ZX-80/81 to crash.

Poking individual numbers into consecutive addresses is all very well for small routines, but is rather cumbersome for a long machine-code routine. A ready alternative is the Hex loader. The Hex loader is a short program which Pokes a series of Hexa-

decimal pairs into consecutive addresses.

This is extremely useful for long routines as the loader program can be deleted once the machine-code subroutine has been loaded. Let us look at two examples:

```
10 POKE 17000, 33
20 POKE 17001, 0
30 POKE 17002, 0
40 POKE 17003, 57
50 POKE 17004, 201
60 PRINT USR (17000) - 16383
```

This is a test for the amount of memory in circuit — 1024 for a 1K machine and 16384 if the 16K RAM pack is fitted. We can also load the machine-code routine with the Hex loader. ZX-81 owners will have to change lines 60 and 90 of the routine to emulate TL$ as given in the manual.

```
10 LET A=17000
20 LET B=A
30 LET A$="21000039C9"
40 LET C=CODE (A$)
50 IF C=1 THEN GOTO 120
60 LET A$=TL$ (A$)
70 LET D=CODE (A$)
80 POKE A, 16* (C -28)+D-28
90 LET A$=TL$ (A$)
100 LET A=A+1
110 GOTO 40
120 PRINT USR (B)-16383
```

At first glance, this looks complicated, but all it does is Poke the first Hexadecimal pair into the start address 17000, the second pair into the second address 17001, and so on. Line 30 assigns A$ which contains the Hexadecimal pair reprentations of the decimal numbers you Poked in the first program — 21=33; 00=0; 39=57; C9=201.

Because of the way Sinclair Basic works, A$ can contain up to 255 characters — more than enough for most machine-code routines. Michael Kirkland of the National ZX-80 and ZX-81 Users' Club has written the following program to find the address of any given point in a Basic program. Although each Hexadecimal pair is written separately with comments, they should be run together without spaces as A$ of the Hex loader.

Address	Hex code	Comments
17300	21	Load HL
17301	28	16424 — start of program
17302	40	
17303	3E	Load A
17304	08	Key chr
17305	23	Increment HL — obtain next address
17306	BE	Compare content of HL
17307	28	Jump if zero
17308	03	to 17312 — check for 9 if 8 found
17309	20	Jump if not zero
17310	FA	to 17305 — try again if not found
17311	C9	Return to USR if finished
17312	23	Inc HL if 8 was found — obtain next address
17313	3E	Load A
17314	09	Key chr
17315	BE	Compare content of HL
17316	C8	Return if zero — return to USR with address in HL
17317	20	Jump if not zero
17318	FO	to 17305 — try again

The number in address 17301 must be changed to 82 for the ZX-81 and new-ROM ZX-80. To operate this program, you must insert any two characters not used elsewhere. We use 08 and 09 in this example. The machine-code routine searches for, and gives the address of, 08 followed by 09.

Type the Hex loader again and assign the string of Hexadecimal pairs to A$. Change line 10 to:

```
LET A=17300
```

and line 120 to:

```
PRINT USR (B)
```

If you add a Rem statement after the program, i.e., 130 Rem — char 08; char 09 — when you Run the program, the computer will print the address of the first character.

Allowing for time to load the machine-code routine, the result is almost instantaneous. The Basic version

```
IF PEEK (A)=8 THEN
IF PEEK (A+1)=9 THEN PRINT A
```

will take several seconds to execute.

The characters the program is seeking should be input at 17304 and 17314. Although the listing starts at 17300, the program does not contain any absolute addresses and can, therefore, be located wherever convenient.

We shall look at just one more example of machine code, and yet another way of entering the routine. This is a re-number program written by Ian Craig and was first printed in *Interface*, the magazine of the National ZX-80 and ZX-81 Users' Club.

This loader program allows you to enter the op codes as decimal rather than hexadecimal numbers:

```
9000 LET A=(start address of routine)
9010 FOR B=A TO A+37
9020 PRINT B
9030 INPUT C
9040 POKE B, C
9050 CLS
9060 NEXT B
9070 LET D=USR (A)
9999 STOP
```

Type in Run 9000 and the start address number appears on the screen. Enter the first number and press Newline. Do this until you have entered all the numbers. The ZX-80/81 will then execute line 9070 which tells the computer to Run the machine-code routine — this will remember the program. The list of op codes is:

```
 33 }
 40 } LD HL
 64 }
 17 }
 10 } LD DE
  0 }
114   LD D, (HL)
 35   INC HL
115   LD E, (HL)
  6   LD B
 10   10 (steps of line numbers)
 19   INC DE
 16 }
253 } DJNZ (Jump until B=0)
 35   INC HL
126   LDA, (HL)
254 }
118 } CP 118
 32 }
250 } JRNZ
 35   INC
126   LDA, (HL)
254 } CP39 (highest significant
 39 } byte of line 9999)
 32 }
  6 } JRNZ
 35   INC HL
126   LDA, (HL)
254 } CP 15 (lowest significant
 15 } byte of line 9999)
200   RETURN IF ZERO
 43   DEC HL
114   LOA, D
 35   INC HL
115   LDA, E
 24 }
228 } JR
```

AFTER THE MANUALS...

You may be wondering what on earth to do with your ZX-80 or ZX-81 once you have worked through the manuals. Tim Hartnell obligingly shows you the way into new programming territory with an explanation and example listings of random-number generation — the key to writing games programs.

PLUG IN YOUR machine and position the cursor — that is the white K on a little black square — in the left-hand corner of your screen, and input the following, which generates a series of random numbers. You will be using random numbers time and time again in games:

ZX-80

```
10 PRINT RND(10);" ";
20 GOTO 10
```

ZX-81

```
10 PRINT INT(RND*10)+1;" ";
20 GOTO 10
```

These programs will cause the screen to fill with random numbers between one and 10. They are of absolutely no use at all as they are, but become invaluable when used as part of a game.

The following program uses the random-number generator to produce numbers between one and six in the game of Russian Roulette. The principle of the game is simple. You have a pistol with six chambers, only one of which contains a bullet. You point the pistol at your head, pull the trigger, and hear either a bang or a click. Input the program, Run it a few times:

```
10 PRINT "RUSSIAN ROULETTE"
20 PRINT "WHAT IS YOUR NAME?"
30 INPUT A$
40 PRINT
50 PRINT "DO YOU WANT TO PLAY,
";A$"?"
```

(continued on next page)

(continued from previous page)

```
60 INPUT B$
70 CLS
80 IF B$="NO" THEN GOTO 270
90 LET J=0
100 PRINT "PRESS NEWLINE TO FIRE"
110 INPUT C$
120 CLS
130 LET J=J+1
140 LET G=RND(6)
    This version is for the ZX-80. If you have
    a ZX-81, change the line to LET G=
    INT(RND*6)+1
150 PRINT A$;", ";10-J;" SHOTS TO GO"
160 PRINT
170 IF G<6 THEN PRINT "CLICK"
180 PRINT
190 IF G=6 THEN GOTO 220
200 IF J=10 THEN GOTO 250
210 GOTO 100
220 CLS
230 PRINT "BANG...";
240 GOTO 230
250 PRINT "YOU HAVE SURVIVED, ";A$
260 GOTO 250
270 CLS
280 PRINT "CHICKEN...";
290 GOTO 280
```

There is an extraordinary number of things you can learn from this simple program:

10 PRINT "RUSSIAN ROULETTE"

Firstly, you see that every line begins with a line number. On a Sinclair computer, the line numbers can be any from 1 to 9999, but you will find it best if you work in multitudes of 10 or so because it gives you space to add extra lines between any you already have in the program.

Extra lines sort themselves automatically into the correct order. The computer always processes each line number in order from smallest to largest — unless it is told during the course of a program to go to some other line.

Next we have the word Print — probably the most-used command in the computer language Basic, which is what your ZX-80 and ZX-81 use. You follow the command Print with what you want printed in quotation marks. In this case, it is the words Russian Roulette.

Try adding a comma just before the first set of quotation marks so the line reads

10 PRINT, "RUSSIAN ROULETTE"

Run the program again and you will find the computer moves the words across the screen. The use of a comma in this way is ideal for setting out print statements in columns — ideal for printing boring tables of figures.

The line 20 asked your name, and then stopped when it reached line 30 — Input A$. This A$ — a letter followed by a dollar sign — is called a string in Basic and can be made equal to any combination of letters, characters and numbers. We shall stay with letters for the time being.

The computer stopped and waited for you to input a string. After you typed in your name, and pressed Newline so the computer would accept it, the screen cleared. The CLS line means "Clear the screen" but the computer still remembered what A$ had been made equal to, and used it to print your name next time A$ appeared in the program.

Next, the computer asked you if you wanted to play, line 50, and accepted a second string, B$, in line 60 as your answer. Now, the ZX-80 and ZX-81, like all computers, can make decisions and act on them. In this case, in line 60, it looks at your answer, B$, to the question and if the answer is No — that is, if B$ equals No in line 80 — it directs control to line 270, which clears the screen.

Control then passes to the next line, 280, where the word "chicken" is printed. Line 290 repeatedly sends control back to 280 until the screen is full and the program stops. You will see that the word "chicken" forms an attractive pattern, and if you want something to develop this further use a perpetual loop and a few graphical symbols in a Print statement, to create patterns to fill the screen.

In Russian Roulette, if you do not answer No when asked if you want to play, the computer moves along to line 90 where the variable J is assigned to the value zero. In Sinclair Basic, any letter or combination of letters and/or numbers starting with a letter can be assigned to a value. So, line 90 could say, for example:

LET SUM=0 or LET PQ4=8

You follow the instruction printed by line 100 and the screen clears yet again, line 120. Line 130 adds one to the value of J so J becomes equal to one. Next time, it will add one again, so J will equal two and so on.

Line 140 is our old friend the random-number generator. Line 150 tells you how many shots from 10 you have left. Note that in Sinclair Basic, you can combine strings, Print statements and computation in a single line. The ZX-80 or ZX-81 works out what each part of the line means before it prints it.

Line 160 prints a blank line and then line 170 makes another decision. This kind of statement is known as an If/Then statement because is takes the form If some condition exists Then do something — If the house is on fire Then scream. The condition can be almost anything from

IF X=96 to IFA$="FROG"

to complicated conditions like

IF A–B> 2*Z–Q/2 THEN

Anyway, this If/Then statement checks to make sure the random number generated is less than six, and if it is, it prints "click". If it is not, the computer continues to scan the program line by line until it finds something it can do.

If G is equal to six — line 190 — it sends control to line 220 which uses a similar idea to the one we discussed for "chicken" to print the fatal word "bang". Assuming that G is less than six, the computer will print "click" in line 170, print a blank line in 180, ignore line 190 and then arrive at line 200.

When it reaches there, it will check to see what value has been assigned to J. If it equals 10, you have won the game, so the computer sends control to line 250 to tell you. If J does not equal 10, the computer ignores line 200 and then finds, at line 210, a command it can obey, and sends all the action back to line 100.

Once you have killed yourself a number of times with the game, add and/or change a few lines in the program to allow the player to have a new game if he or she survives the first version without having to return the command mode. There is an enormous number of ways the modification can be made.

Probably the simplest way is to add the following:

```
255 PRINT "DO YOU WANT ANOTHER GO?"
```

and change line 260 to read Goto 60. By doing this, you use the routine of lines 60, 70 and 80 twice. You may well have done it differently. It does not matter what changes you made, as long as it achieves the desired end.

There is another way we could have produced that same effect — by use of a subroutine. Whenever a computer encounters a Gosub — GO to SUBroutine — command, it goes to the line specified and follows on until it meets the command Return. The computer then returns to the line after the Gosub command. Make the following changes to your Russian Roulette program and this should be clearer:

Change line 60 and line 260 to Gosub 300 and delete lines 70 and 80. Now add the following which is the subroutine:

```
300 INPUT B$
310 CLS
320 IF B$="NO" THEN GOTO 270
330 RETURN
```

This time, when you run the program, the computer will be sent to the subroutine when it reaches lines 60 or 260. Here is a program of stunning complexity which relies heavily on repeatedly going to a subroutine:

```
10 LET A$="KALKI, THE MIND-READER
   SAYS"
20 GOSUB 340
30 PRINT "WHO OWNS THIS COMPUTER?"
40 INPUT B$
50 PRINT "PRESS NEWLINE AFTER EACH
   STEP"
60 GOSUB 320
70 PRINT "THINK OF A NUMBER"
80 GOSUB 320
90 PRINT "DOUBLE YOUR NUMBER, ADD
   4"
100 GOSUB 320
110 PRINT "DIVIDE BY 2, THEN ADD 6"
120 GOSUB 320
130 PRINT "SUBTRACT THE NUMBER YOU"
140 PRINT "FIRST THOUGHT OF"
150 GOSUB 320
160 PRINT "SUBTRACT 3, THEN"
170 PRINT "MULTIPLY BY 5"
180 GOSUB 320
190 PRINT "SUBTRACT 3 AGAIN"
200 PRINT "AND DIVIDE BY 2"
210 GOSUB 320
220 PRINT "WRITE DOWN YOUR ANSWER"
230 GOSUB 320
240 PRINT "HOW MUCH MONEY DO YOU"
250 PRINT "HAVE IN YOUR POCKET (IN P)?"
260 INPUT A
270 GOSUB 330 (Note: Not 320)
280 PRINT "THE NUMBER WRITTEN DOWN
   IS 11"
290 PRINT "WHEN YOU LEAVE, PLEASE"
300 PRINT "GIVE";B$;"£";A/100;" AS A
DONATION"
310 STOP
320 INPUT C$
330 CLS
340 FOR J=1 TO 5
350 PRINT
360 NEXT J
370 PRINT A$
380 RETURN
```

Many of the features we have discussed in connection with Russian Roulette apply to Kalki, The Mind-reader. After running the program a few times, you can change the Print statements to create a totally new game. Once you are tired of that, devise your own program to create designs using subroutines. We shall be looking at more complicated programming techniques for the ZX-80 and ZX-81 in the next issue of *Your Computer*. ■

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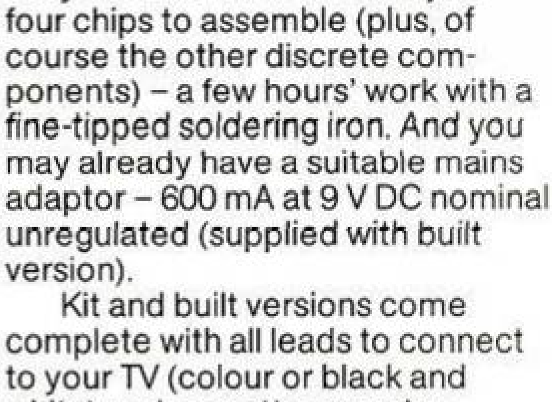
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GRAPHIC PROOF OF ATOM POWER

BY ROY BURGIN

Simulating explosions by flashing the screen, inputting graphics from the keyboard and "splitting" the Atom are the three techniques revealed by Atom adept Roy Burgin who provides the listings and programming know-how to accomplish them.

WHILE LOOKING through the Acorn Atom *Magic Book,* I noticed that the memory location #E7 — # equals Hex on the Atom — contains a number associated with the shift/lock key. This value is normally zero but is Exclusive-ORed with #60 every time the shift/lock key is pressed while the computer is looking for an input.

When an alpha key is pressed, i.e., A to Z, the value returned in the computer's accumulator from the key is ORed with the value stored in #E7 before further processing. What this means is that the key pressed accesses a different part of the ASCII table.

It is this fact that I use in the program to shift to any part of the table by changing the value in #E7. You can do this from the keyboard by typing ?#E7 = (any number).

The number you type will be truncated to the last eight binary bits, i.e., 0 to 255. After doing this, you will probably have to press the break key if you want any sense from your Atom; it will re-set the value to 0.

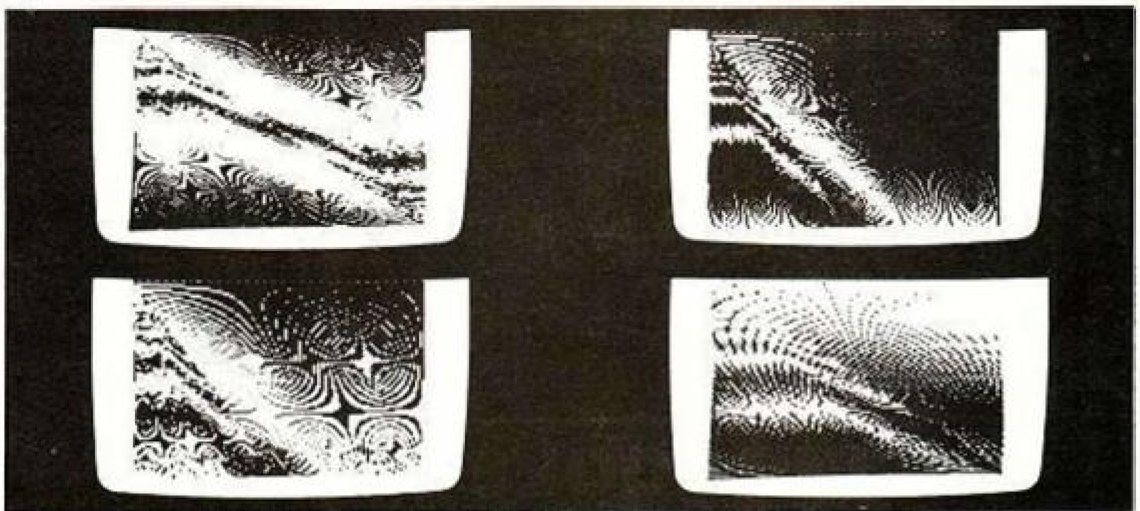
The program given in listing 1 assembles a machine-code routine into a portion of free RAM just above the addresses of floating-point arrays from #28CO to #28FE.

The program then patches it into the normal input routine to give six graphic lock keys — CTRL1 to CTRL6 — and a graphic clear key — CTRL0. These are set out in table 1.

Normal (CTRL)Ø	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
(CTRL)1																
(CTRL)2																
(CTRL) (SHIFT) 1																
(CTRL) (SHIFT) 2																
(CTRL)3																
(CTRL)4																
(CTRL)5	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?	
(CTRL)6	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/	0

Keys Q–Z repeat A–J in other groups. shift in modes 3–4 gives control characters

Table 1.



Four of the 16 patterns produced by listing 2.

Unfortunately, the full range of white graphics are not accessible as direct ASCII codes because of the control codes 0 to 31. You can see the available set by typing

```
FOR I=32 TO 255;PRINT $I;NEXT I
```

If you include 0 to 31 the computer will turn off the screen when it reaches 21 — CTRL U — and will appear dead. This can be returned to normal by typing

```
(CTRL F), BREAK
```

or by causing an input error — that is, type any rubbish and press return.

The remaining white graphics can be accessed only by placing the appropriate value in the screen memory. However, the program gives you 32 white graphics, all 64 grey graphics and 32 inverted numerals and punctuation.

Because there are only 26 alpha keys, and the ASCII table is arranged in Hexadecimal form, I have chosen to use only 16 of the keys in each group so that they follow a logical sequence. You will find that the keys Q to Z produce the same characters as A to J in another group.

The Shift Lock still operates as normal and is needed to produce half the grey graphics. If, however, it is used while in modes 3-4, control characters will be input, and if used while in modes 5-6, you will be back to the characters available from the normal keyboard.

Pressing the Break key when the routine has been installed will destroy the patch and return the computer to normal. If you inadvertently cause this to happen, you can restore the patch by typing:

```
?#20A=#C0; ?#20B=#28 (Return)
```

This must be done as a one line input as shown — if you do not, the Atom will crash.

After loading and running the program, type New and continue as normal. You will notice no difference in the Atom's operation unless you want to switch off the screen using CTRL U as this is the same code as CTRL 5 and now acts as a graphic lock key.

However, type

```
P.$21
```

and this will turn off the screen for you. When you wish to input a graphics character from the keyboard, either for inclusion in a string during program development, or as part of a string input to a program which is running, look up the character you want in the table. Then press CTRL and the appropriate number and press the required key. Return the keyboard to normal by typing CTRL0.

(continued on next page)

(continued from previous page)

When these graphic-lock combinations are used, the routine does not pass the characters on for further processing thus preventing errors as is normal with control codes.

Try typing CTRLG and return and you will obtain an error message. The same does not now apply to CTRL0-6 return. Now type:

P.' ' ' ' ' "(CTRL 2)NJJ" ' ' ' ' ' (CTRL 0) (Return)

in place of the NJJ you will see the appropriate graphics.

When you hit the klingon, alien, vogon or krell with your laser or photon torpedoes, you can produce a satisfying explosion by making the screen flash using the following short routine

```
F.I=1TO8;?#B000=#F0;WAIT;
?#B000=0;WAIT;N.
```

Change the #F0 to R. and you will obtain a series of random flashes. All it does is to quickly switch between graphics modes without clearing the screen. If you are using one of the lower graphic modes, the effect can be made more dramatic by filling the unused higher graphic memory with white — that is, fill each location with the value #FF.

If you have an unexpanded Atom, try experimenting with other numbers — see page 88 of *Atomic theory and practice*. Do not forget to switch back to the graphics mode in which you started after the explosion — see also page 88 of the manual.

If you play around with the timing of the explosions routine, you can set your program into a loop which locks into the same timing as the transfer of signals to the television screen.

The switching takes place very quickly and it is possible to start the screen in one mode and change it to another mode part of the way down the screen. The switching position can be adjusted very accurately by the addition of semicolons for coarse timing — each semicolon has to be evaluated by the Basic interpreter — and extra spaces for fine timing.

The program given in listing 2 works perfectly on my Atom but may need adjustment on yours — especially if you do not have the floating-point ROM fitted. The reason for this is that evaluation of the semicolon takes longer when the floating-point ROM is fitted.

The program should produce three complete lines of text in mode 0 followed by a Moire pattern created in mode 4 and reproduced in a continuous sequence of views in other modes and colours — it should look good in colour.

With careful adaption, this routine can be a useful programming tool as you can display half the screen as characters and the other half in graphics mode 4 using only 3K of RAM. The program given is locked in a loop and can be interrupted only by pressing break or Esc. If, however, the "U.O" is substituted by

"U.?E<>255"

where E has been previously set equal to #B001. You will be able to continue your program by pressing the Shift key. If this causes the screen to flicker, it means that you have put too much delay into the overall loop and execution time is greater than the frame-refresh time.

If you look carefully at the photographs you will notice that I added a few extra graphics characters into the print statement using the keyboard graphics program. ■

```
 50 REM   GRAPHIC  CHARACTERS DIRECT FROM THE KEYBOARD
 60 REM (c) COPYRIGHT R.F.BURGINJUNE 1981
 70 REM RESIDES IN RAM AT      #28C0 TO #28FE
100 DIM BB9
110 J=#20A
120 K=!J&#FFFF
130 FOR I=0 TO 1
140 P=#28C0
150[
160:BB8 JSR K     GET KEY
170 CMP @16       IS IT (CTRL)0
180 BEQ BB0       IF YES, BRANCH  ELSE
190 CMP @17       IS IT (CTRL)1
200 BEQ BB1       IF YES, BRANCH  ELSE
210 CMP @18       IS IT (CTRL)2
220 BEQ BB2       IF YES, BRANCH  ELSE
230 CMP @19       IS IT (CTRL)3
240 BEQ BB3       IF YES, BRANCH  ELSE
250 CMP @20       IS IT (CTRL)4
260 BEQ BB4       IF YES, BRANCH  ELSE
270 CMP @21       IS IT (CTRL)5
280 BEQ BB5       IF YES, BRANCH  ELSE
290 CMP @22       IS IT (CTRL)6
300 BEQ BB6       IF YES, BRANCH  ELSE
310 RTS           PASS CHARACTER TO INPUT PROCESSING
320:BB0 LDA @#00  (CTRL)0
330 BEQ BB9
340:BB1 LDA @#F0  (CTRL)1
350 BNE BB9
360:BB2 LDA @#E0  (CTRL)2
370 BNE BB9
380:BB3 LDA @#B0  (CTRL)3
390 BNE BB9
400:BB4 LDA @#A0  (CTRL)4
410 BNE BB9
420:BB5 LDA @#50  (CTRL)5
430 BNE BB9
440:BB6 LDA @#40  (CTRL)6
450:BB9 STA #E7 STORE MOD       VALUE
460 JMP BB8       GET NEXT KEY  WITHOUT PROCESSING LAST
470]
480 NEXT I
490 ?J=#C0        ;REM SET PATCH INTO INPUT ROUTINE
500 J?1=#28
510 END
```

Listing 1.

Listing 2.

```
50 REM Moire pattern in mode 4 with title in mode 0
60 REM locked into a loop to multiplex time sharing
70 REM of the screen between mode 0 and others in a
80 REM continuous sequence including colour changes
90 REM (c) COPYRIGHT R. F. BURGIN JUNE 1981
100 CLEAR 4
120 FOR I=0 TO 255
130 PLOT 4,I,30; PLOT 6,0,188
140 PLOT 4,(255-I),188; PLOT 6,255,30
150 NEXT I
180 P.$30"(32 spaces)"
190 P."(9 spaces)moire patterns(9 spaces)"
200 P."(32 spaces)"
210 REM Timing loop, may need adjustment
220 F=#D0; C=#B000; D=#B002; U=300; T=0; ?D=0
230 DO WAIT; ?C=0;(approx 26 spaces);
240 ?C=F;T=T+1
250 IF T>U;T=0;?D=?D:8;IF?D&8=8;F=F+#20
260 U.0
```

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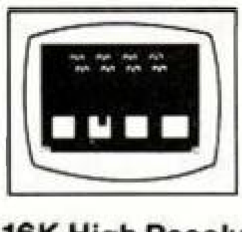
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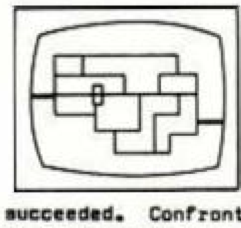
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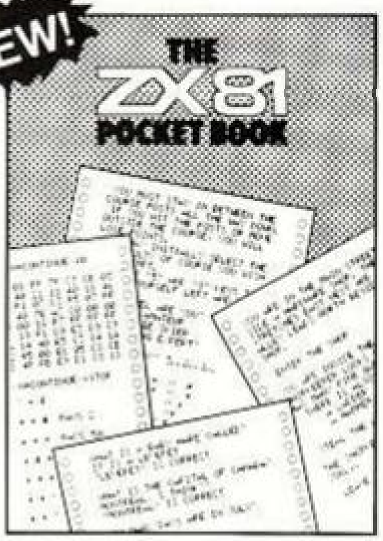
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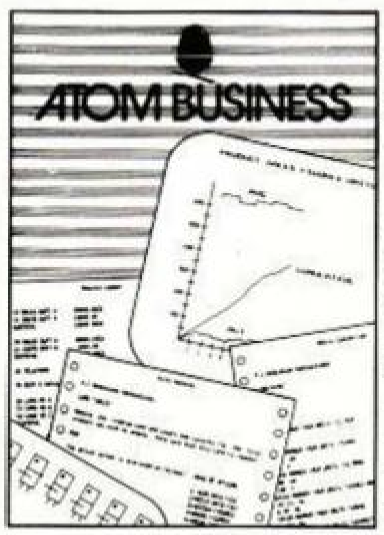
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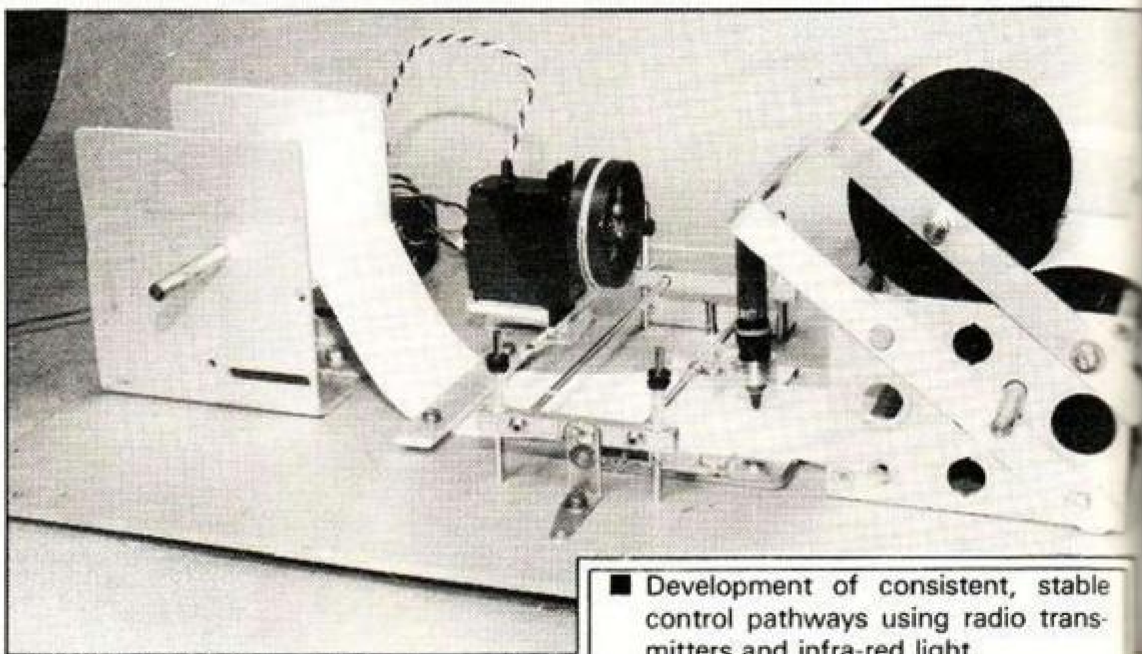
About three-quarters of the individually-owned micro-computers in the U.K. are used wholly or predominantly for playing games. That is a shame — games deny users the rich variety of experience a computer can generate. In the first part of a new series, John Dawson looks at applications which will carry your micro beyond recreation into the realm of computer control.

THE GAMES people play tend to involve little more than packaged software and interaction between the computer user, the visual display unit, VDU, screen and the computer keyboard. Microprocessors can, however, be put to any task for which a program has been written. This series is about extending the input and output devices which can be attached to an ordinary, domestic microcomputer to explore the uses of the computer for control purposes.

Some of the extensions are likely to take the form of electro-mechanical devices, such as the pen recorder described in this article, and these will be built in what may be best described as prototype form. The pen recorder, for example, produced good results when used with a certain amount of care and attention by the builder. It is not, however, suitable for use in a rugged environment or by anyone who does not understand the construction and the limitations.

There is all the difference in the world between the working robot arm which can be used to lift and manipulate objects in a reasonably well-controlled domestic environment and the multi-purpose robots marketed for arc welding and other purposes. The amount of development work necessary to allow a robot to operate reliably when it is close to the massive power surges generated by arcs of several hundred amps' intensity must be colossal, the electro-magnetic disturbances generated by arc welding can cause transient interference to even well-protected microelectronic equipment throughout an entire neighbourhood.

This series will be the record of several amateur experiments — some involving hardware and others the development of software, a control-orientated interpreter, for example, for a Tangerine Microtan computer. Targets for the series are the development of an intelligent vacuum cleaner, an electronic-scanning camera and the other projects set out in table 2. On the route to those targets I hope the series will enter some curious byways of control electronics.



The pen recorder.

The general principle of using a computer to control a process is shown diagrammatically in figure 1. Instructions are sent from the computer to the output device and the controlled process is altered in some way. For example, an actuator may open a skylight in a greenhouse to increase the ventilation. An input sensor, an electronic thermometer in the greenhouse, monitors the air temperature and data from the thermometer is read by the computer so that the skylight can be opened further if necessary, or closed when the air temperature drops in the evening.

A system in which some quantity in a process is measured so that a controlling influence can be applied to the process to keep it within desired limits is a closed-loop feedback system.

Life is a closed-loop system. The organisation in a plant which makes the tip grow towards a source of light is a biochemical closed-loop system and there are examples in all the animals from the simplest invertebrates to the most sophisticated mammals.

Figure 8 illustrates a simplified human nerve pathway from the spinal cord to a fibre in a muscle. The contraction of the "A" muscle fibre is controlled by impulses travelling from the spinal cord down the alpha nerve, 3. Impulses that arrive at the muscle make the muscle shorten and that reduces the tension in the "B" fibres.

There is a sensor for stretch in the middle of the "B" fibres which sends fewer nerve impulses, 1, to the nervous system when the tension in the "B" fibres is reduced. The synapse is a connection between the incoming sensory nerve, and the outgoing large, alpha, motor nerve, 3.

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- Development of an intelligent vacuum cleaner with software protocols for action after encountering obstacles and to avoid tangling the mains cable. Also the problems of switching mains voltages.

Table 2.

If the "A" muscle fibre is stretched suddenly, for example, by tapping just below a person's knee, the stretch receptor fires a burst of electrical activity up the sensory nerve to the spinal cord — shown in cross section — and this is transmitted back to the muscle fibre causing it to contract abruptly, and the person's leg jerks. This simple closed-loop system is regulated by the impulses from the brain down the gamma nerve, 2, to the "B" muscle fibres.

Increased activity in the gamma nerve causes the "B" fibres to contract and this

MICRO APPLICATIONS

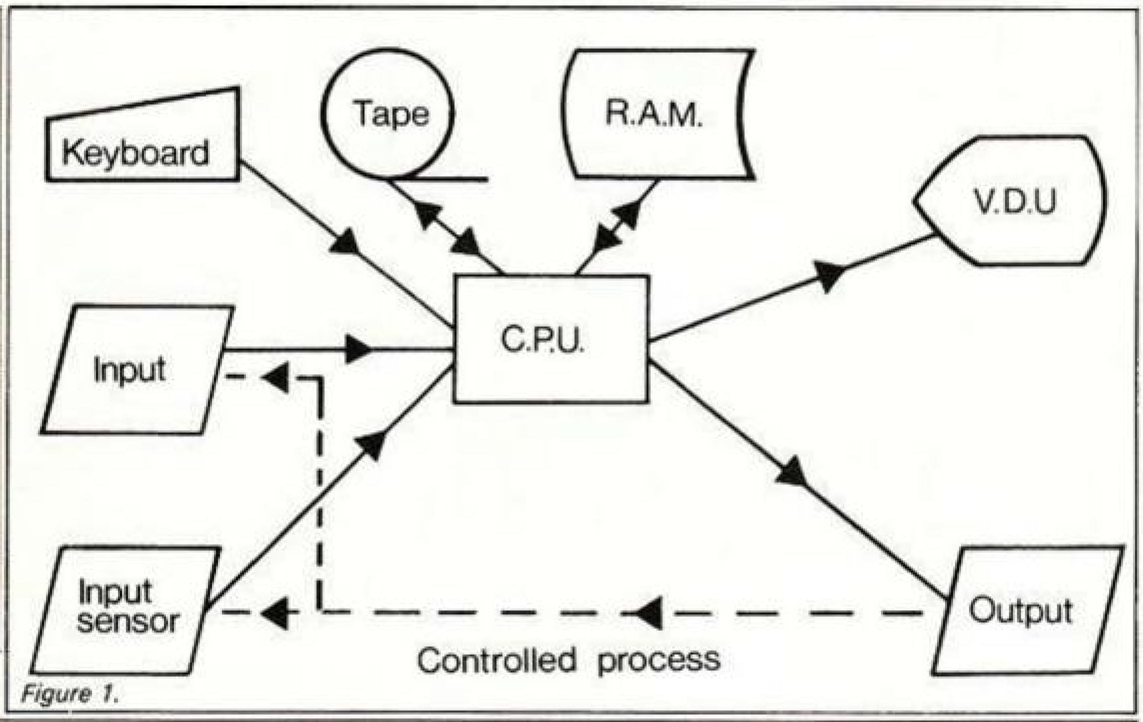


Figure 1.

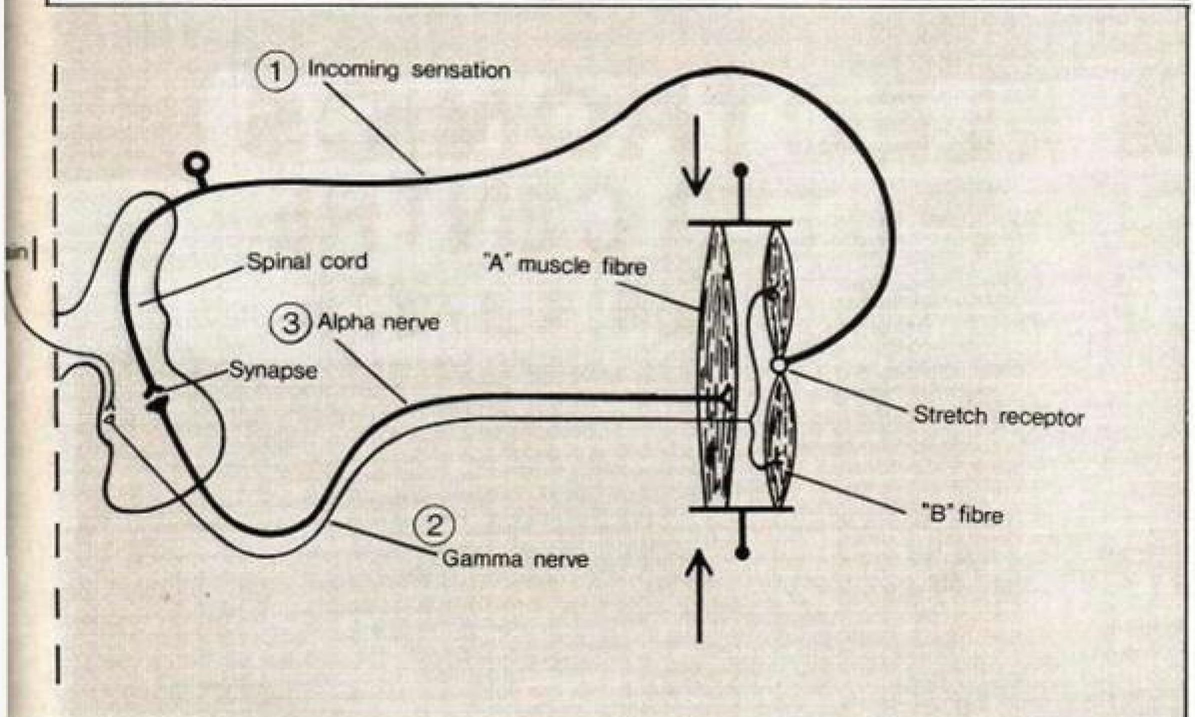


Figure 8.

increases the tension on the stretch receptor which initiates activity in the sensory nerve. The "A" muscle fibre is then forced to contract by impulses travelling down the alpha motor nerve.

When the feedback in the closed loop is disturbed in some way, the system becomes uncontrollable and the muscle, the actuator, may become almost rigid, may lose its tone and become limp or may alternate between the two producing jerky, oscillatory contractions.

Feedback and control systems are found at all levels of organisation from single nerves to entire populations. Figure 2 illustrates a closed loop formed by a person playing a game on a microcomputer. When the program has been loaded from the tape the computer, CPU, displays information on either the VDU or another output device.

The information is absorbed visually by the user and after some internal processing an appropriate response is put into the computer by way of the keyboard. Space Invaders is a classically simple example; the required quantity to be measured is the side-to-side alignment of a laser gun with an alien spaceship and when the operator perceives that this condition has occurred, a key is pressed on the keyboard to make the gun fire.

It would be possible to put a microprocessor on to a vehicle but that will tend to restrict the power of the computer and inhibit the development of flexible general-purpose software. For these and other reasons I decided to use standard microcomputers such as the Nascom 1, Tangerine Microtan or Sharp MZ-80K for writing software and control purposes, and to evolve methods of transmitting commands and data to a comparatively "dumb" remote device with a corresponding transfer of sensory information from the device back to the computer.

Figure 3 shows the principles of a closed-loop telemetry system. Microcomputers based on popular CPUs such as the 6502 and Z-80 chips carry data along eight parallel wires, the data bus, and this is a very inconvenient form in which to transmit the information outside the computer case. Many microcomputers have parallel-to-serial converters and the serial output — typically configured to RS232 standards — can transmit digital data using only two wires.

Information in serial form can be sent over considerable distances using a MODEM and Post Office telephone lines. Such a system will not be helpful for the purpose of controlling our vacuum cleaner. However, a MODEM is simply a black box — a modulator/demodulator which changes the digital signal into a form suitable for transmission down a telephone line, recreating the original signal at the far end in another MODEM.

Digital signals can be transmitted just as easily by radio, infra-red or ultra-sonic sound. This series will use radio-control transmitters and receivers as simple and effective MODEMs for sending information to devices which need to be controlled at distances up to 300 to 400 yd. from the computer. An infra-red system will probably be used at some stage for transmission to a device that will stay within the same room as the control computer.

Figure 3 shows how information passes from the CPU to a digital-to-analogue converter, D-A, and from there to the radio control transmitter, Tx. A coded stream of pulses, varying according to the analogue input to the transmitter, is broadcast and received by a miniature receiver mounted on the device to be controlled.

On its own, that is a blind process — the CPU cannot know whether or not its commands have been executed. Nor, at any time, can the CPU know what is the current status of the device. It is the second stage, the transmission of information from the device back to the computer which closes the loop.

The remainder of this article deals with details of a radio-control system, its connections to the microcomputer and subsequent testing of the first stage of the

(continued on page 49)

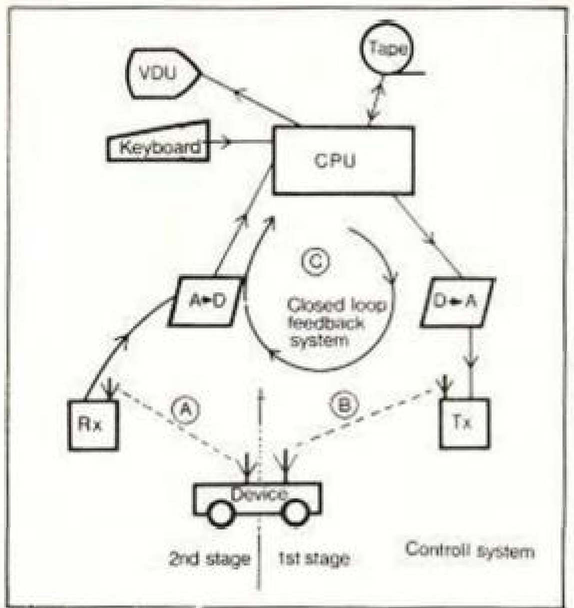


Figure 3.

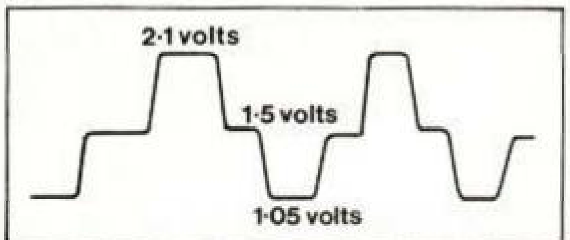


Figure 5.

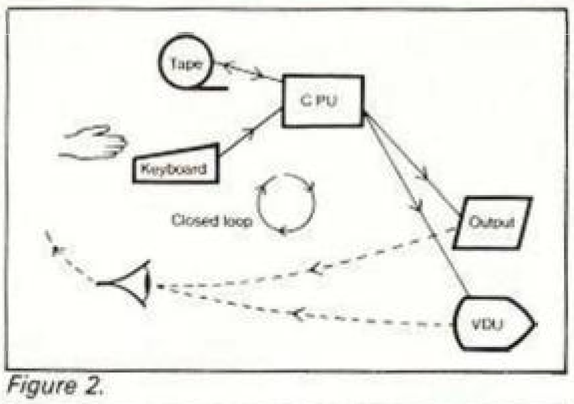


Figure 2.

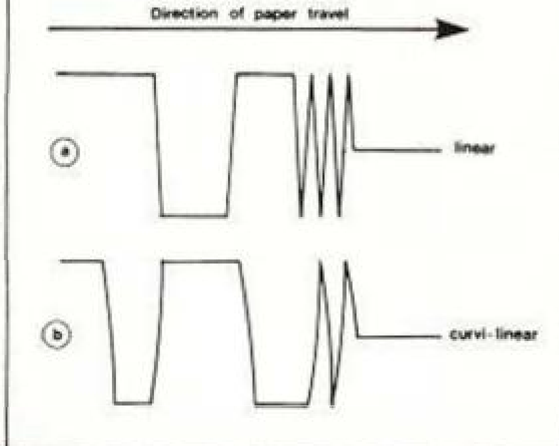


Figure 4.

(continued from page 47)

system by using a model servo to operate a pen recorder.

The Acoms AP-435 radio-control system is one of many now available in High Street model shops. Integrated circuits have changed the nature of radio control out of all recognition in the last few years and two- or four-channel digital proportional control is a standard configuration rather than an esoteric dream.

Since January 1981, the Home Office no longer requires a user of radio-control equipment to buy a licence and has opened a new 35MHz band for model-aircraft control only to avoid interference from citizens' band transmitters operating in the 27MHz frequency allocation.

Figure 9 illustrates the Acoms AP-435 digital proportional radio-control system. Technical data from the information supplied with the system is most intriguing and the most remarkable data revealed is that a servo weighing only 45 gm. can generate a torque of not less than 3 kg. cm.

Used as an ordinary radio-control system, up-and-down or side-to-side movement, W, of the joystick arm, a, is translated into a varying DC potential at the wipers of the potentiometers connected to the joysticks and this is reproduced as a rotary movement, X, of the servos, b. There are a number of unused pins on the IC encoder in the Acoms transmitter which could accommodate two or more miniature push switches.

The identifying numbers on the encoder chip are shown in figure 10 and if you find such a chip in a two-channel transmitter, it is probable that the system can be expanded at the transmitter at least to provide four digital proportional channels and perhaps some other switched on/off channels.

It would be possible to use the computer to mimic the information leaving the encoder chip, using a UART to modulate the transmitter directly. However, the easiest way to control the transmitter, in both hardware and software terms, is to build a simple digital-to-analogue converter taking the analogue output from the CPU to the input on the transmitter encoder chip that was previously connected to the wiper on the joystick potentiometer.

I started to explore the Acoms AP-435 system by separating the two halves of the transmitter case. I mounted two double change-over switches so that the input to the radio control encoder chip could be connected

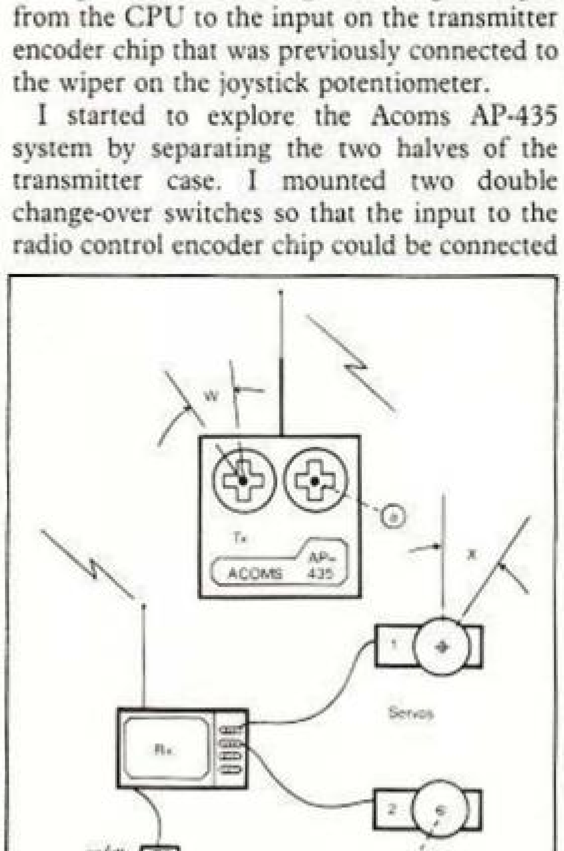


Figure 9.

to either the slider on the joystick potentiometer or to a socket which I attached to the back cover of the transmitter.

After carefully invalidating the guarantee on a new piece of equipment, it is important to have a base line for the performance of the equipment to which you can refer at any time and after re-wiring the connections to the encoder chip, the transmitter still worked faultlessly on manual control using the joysticks.

I was prepared for the transmitter to cause interference to the television set used as a VDU for the Nascom but it was not serious. However, when I connected the input to the encoder chip to the D-to-A converter on a Nascom 1, several unexpected things happened.

The voltmeter attached to the D-to-A converter to measure the analogue voltage at its output started to register strange readings. The servos at the far end of the whole radio-control link became wildly erratic and superimposed on the large movements of the servo was a much faster jitter — perhaps due to the internal operation of the ZN-425E chip.

The strong radio frequency signal from the transmitter was being picked up in the connecting lead between the computer and the transmitter, rectified at some stage and producing spurious DC input signals to the transmitter. When the computer was switched off and disconnected from the transmitter, the servos could still be made to move by touching the input lead to the encoder chip.

Connecting the capacitor C4 — 0.1 microFarad — and the resistor R7 — 56K — to the far end of the input lead to the transmitter solved the problems. Cx is a small capacitor mounted tightly against the input to the encoder chip.

The circuit diagram for a digital-to-analogue converter is shown in figure 10 and is based on the circuit information supplied with the Ferranti ZN-425E converter. The op amp — ZN 424P — is a proprietary Ferranti make and can be replaced with a standard 741. Some minor changes may be necessary to the associated circuit. Although I intend to tidy the construction up at a later date, the tracings and figures in this article were produced by connecting the output of the D-to-A converter directly to the transmitter encoder chip at point W.

Table 1 is a printout of the analogue voltage from the D-to-A converter produced by a digital number typed in on the Nascom keyboard. The maximum output was approximately 2.05 volts and this was generated by the maximum input possible using an eight-bit D-A converter — 255 decimal, FF Hex.

Figure 5 shows the deviation on the pen recorder produced by manual control of the RC transmitter. The voltages marked on the trace were measured at the wiper of the joystick potentiometer at the centre position, and at each end of the joystick travel.

I have included outline details of the construction of the pen recorder only as the machine is not perfect and can be improved without difficulty in a second-generation model. The principle is that a pen is made to move across a sheet of paper in one axis while another axis is produced by drawing the paper past the pen at a constant speed.

If the pen is mounted on an arm and swung across the paper, the resulting trace will be curvi-linear in form. If a sufficiently long arm is used to reduce the distortion to an acceptable amount, the angle through which the pen will swing will be very limited and will fail to exploit the potential of the radio-control servo.

Figure 4 illustrates the difference between a curvi-linear trace and one formed by moving a pen across a band of paper at right angles to the paper's direction of travel. The trace, B, is

(continued on page 51)

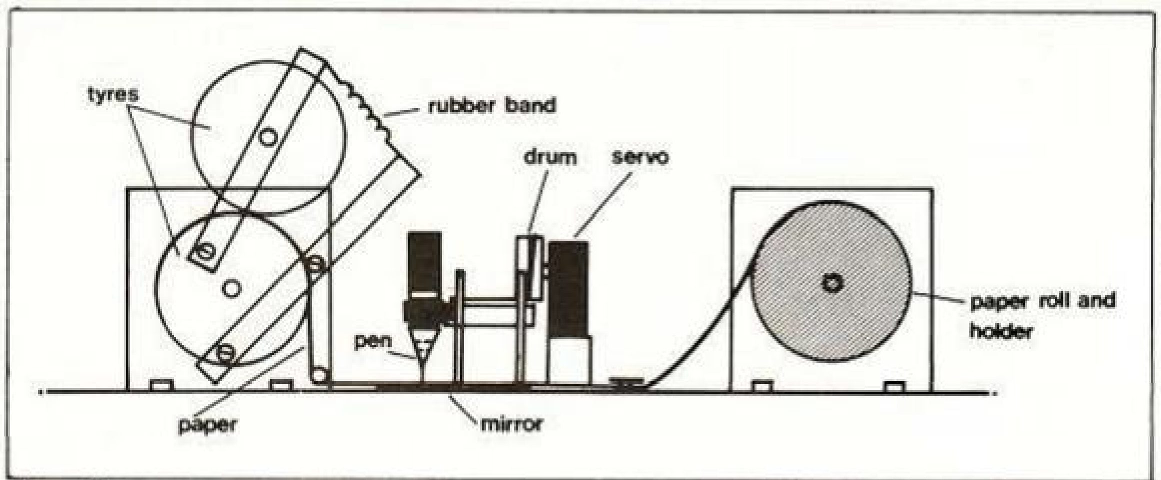


Figure 7.

(continued from page 49)

more distorted. The easiest way — figure 6 — to produce the required linear travel, A, from rotation of the servo arm, A, is to wrap a string round a drum on the servo and use this to pull and push a pen along a rigid, straight guide rail.

The photograph shows how I translated the theory into practice. Figure 7 illustrates the principle of the paper drive. Scrap aluminium — approximately 16 SWG or 2-2.5mm. thick — was used for the paper holder and the mounting for the rollers which form the paper drive.

The base-board was also aluminium but could be made of wood, preferably chip board which is less likely to warp, and I used a cheap mirror, or an equivalent piece of glass, to give a smooth, flat surface for the pen to rest against. After building the recorder, I took the following measurements which may be of help to other constructors:

Dimensions

Paper	width	57 mm.	2.2 in.
	roll diameter	70 mm.	2.8 in.
Servo drum	diameter	43 mm.	1.7 in.
	circumference	135 mm.	5.3 in.
Pen drive frame	width	160 mm.	6.3 in.
Tyre	diameter — uncompressed	60 mm.	2.4 in.

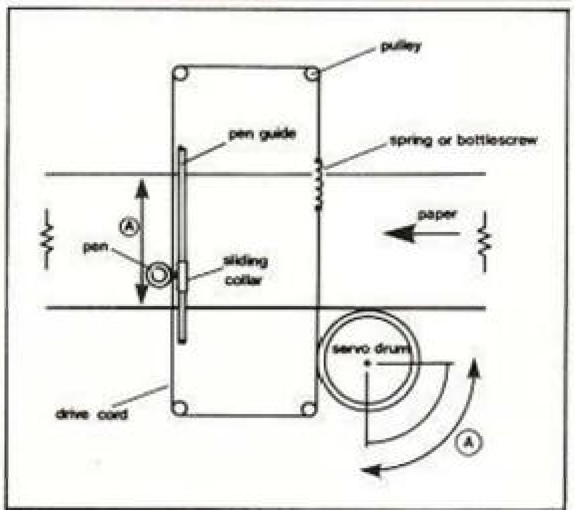


Figure 6.

Base-plate	width	360 mm.	14.0 in.
	depth	290 mm.	11.4 in.

Alternative drive cord 10lb. monofilament nylon fishing line 0.30mm. diameter.

Thin cord was used to drive the pen and some tension was provided by a spring tied into the line. Small brass bottlescrews for yacht rigging are sold in model shops and one of these would keep the drive cord taut while causing less friction when the pen is accelerated by the servo. Nylon fishing line might produce still less friction but may also stretch more.

The pen holder is an adaptor for Rotring drawing pens to allow the nib and ink reservoir to be plugged into a drawing compass. There is a small nut and screw which attaches the metal plug to the plastic body of the holder and that can be screwed directly on to an ordinary 6 BA solder tag which is soldered in turn to the sliding collar on the pen guide rail.

KEYBD INPUT	D-A OUTPUT
255	207 VOLTS
000	- VOLTS
010	- VOLTS
020	005 VOLTS
030	015 VOLTS
040	022 VOLTS
050	030 VOLTS
060	039 VOLTS
070	047 VOLTS
080	055 VOLTS
090	063 VOLTS
100	071 VOLTS
110	080 VOLTS
120	089 VOLTS
130	096 VOLTS
140	105 VOLTS
150	113 VOLTS
160	121 VOLTS
170	130 VOLTS
180	138 VOLTS
190	146 VOLTS
200	155 VOLTS
210	163 VOLTS
220	172 VOLTS
230	180 VOLTS
240	189 VOLTS
250	198 VOLTS
255	204 VOLTS

Table 1.

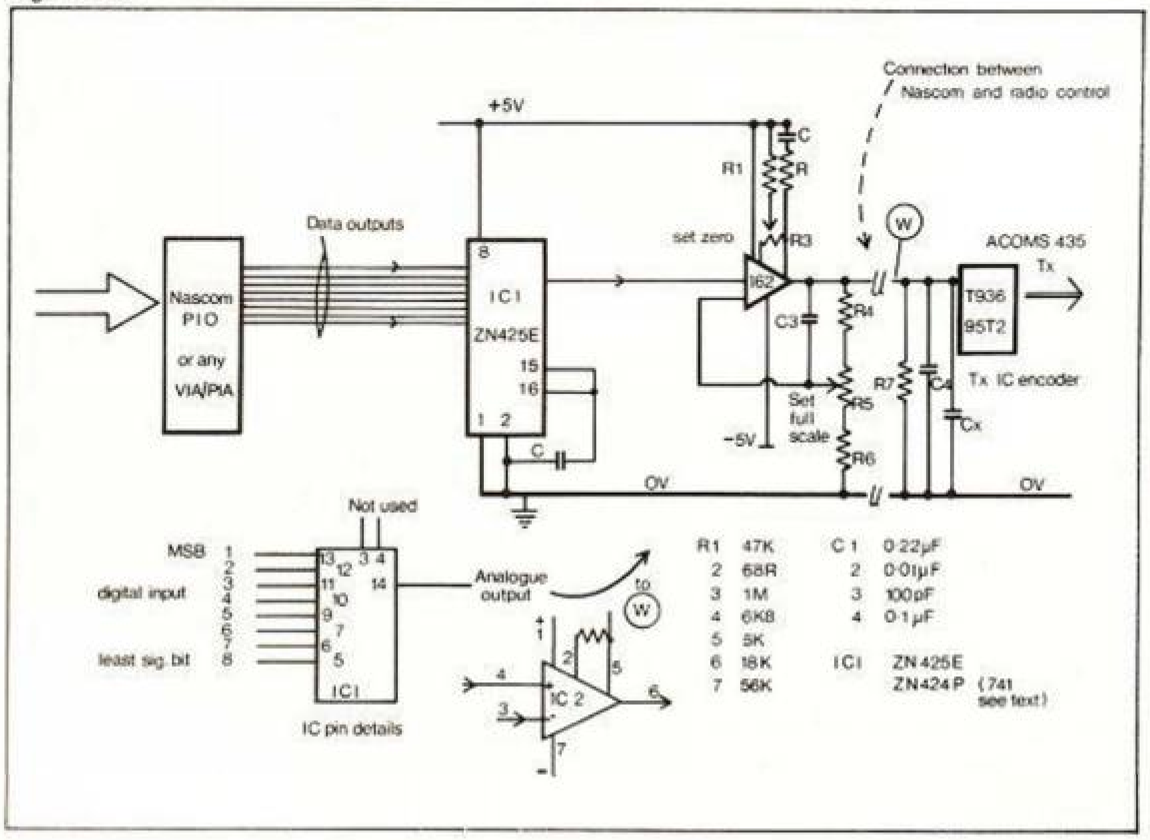
I used the Rotring 0.35mm. Isograph as these pens are much less susceptible to blocking than the older Variant version. The Rotring pens are comparatively expensive and could be replaced by a fine fibre-tip pen. Fibre-tip pens are used by Hewlett Packard for at least one of their flat-bed plotters. The only complaint I have heard is that in the course of producing several graphs or drawings, the width of the line produced by the fibre tip tends to increase slightly.

Most of the other components in the pen recorder were from a local model shop — the servo drum to which the drive cord is anchored is part of a plastic, model-car wheel from a Tamiya kit and the frame for the pen drive is constructed from thin square section brass tube for the sides with smaller diameter round brass tube for the pen guide rails and uprights.

The frame was soft-soldered using an instant-heat solder gun. Most model shops sell double-sided sticky tape for mounting model control servos into aeroplanes, cars or boats. Provided the surfaces to be joined are clean and dry, double-sided sticky tape makes a bond which can be regarded as permanent for all practical purposes. The joints between the servo, the bracket and the pen-recorder base-plate were all made with double-sided tape and the mirror was mounted in the same way.

The rollers which grip the paper are sponge neoprene tyres for model racing cars on strong plastic wheels. The wheels mount directly on to 0.25in. steel axles and tension between the

Figure 10.



(continued on next page)

(continued from previous page)

two wheels is provided by a rubber band. The paper is a roll for ordinary calculating machines from W H Smiths.

I bought a DC model motor with a variable gear set — Ripmax models M-EM141P; Monoperm Super five pole, made by Marx, 6volt, gear ratios from 3:1-360:1 — to drive the paper and I shall probably use the same motor in a later project. However, there is no need to go to that expense as there are many small-geared mains motors on the market which will do at least as well.

I have replaced the DC motor shown in the photograph with a 2.5rpm 240volt AC motor. The speed of the mains motor is a little slow giving a theoretical paper speed of 470mm./minute — 0.3 in./second — but produces very good results for less than £3.

The speed is, of course, immaterial below a limiting value as the rate at which data is output from the computer can be easily controlled by altering the software. The speed at which the pen recorder plots data does not limit the system in any way provided that the application allows data to be acquired quickly by the computer and then output slowly from either the computer's main memory or back up storage at a rate that suits the plotting device.

```
15 S6 S7 (SET PIO TO OUTPUT).
L1 .(INPUT VALUE ) ? =Q
Q,256  JG3 (INVALID ENTRY) JU1 L3
100. Q JG2 (INVALID ENTRY). JU1
L2 S4 S5
. Q=? PL P.  130 S4 S5 JU1
```

Test 1a.

```
00101
00100
00200
00210
00220
00230
00240
00250
00255
```

Test 1b.

Test 1c.



A Nascom 1 computer running under the Duncan interpreter will acquire data at the rate of one reading in under 2mSec. and when the sampling process is completed, the data can be stored either on cassette tape or in the computer memory until it is plotted. Similarly, 24 hours of meteorological data can be gathered very slowly. For example, one reading every three minutes produces 480 values in 24 hours, and then recorded on the pen recorder in less than one minute. Another experiment running on a long time scale may be the solar panel investigation listed in table 2.

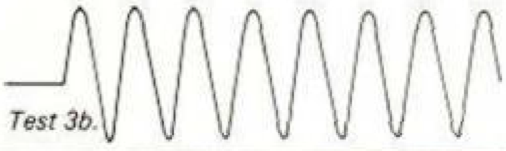
I carried out some initial tests on the radio-control system using a protractor mounted on the servo to measure the number of degrees of rotation produced by varying input voltages to the transmitter. Comparison of figure 5 and table 1 shows how the voltage produced by the D-A converter and the manual potentiometer overlap. The results of the first test using the pen recorder are set out in test 1, which consisted simply of a small Duncan program, a, to take a value from the keyboard and put it out to the PI/O.

When the keyboard value had been printed on a Creed teleprinter, b, a base-line value of 130 was set to the PI/O ports and the program looped back to acquire another value from the keyboard. The trace, c, shows the pen-recorder response.

In Test 2, I used the computer to generate a sawtooth wave-form by incrementing a base value of 90 until the program reached 255. The program then re-set the pen recorder to the base value and the process was repeated. The computer would loop through this program far too quickly for the pen recorder to follow unless each cycle had a built-in delay and the length of the wait state in the Duncan interpreter was adjusted by trial and error until an optimum value was found.

```
(FILL DATA LOG AND PRINT SINE WAVE TO PEN
PLOTTER.)
?.5 JG3
I=D CB L1 ? FA DI=D.91 JG 1
(END OF DATA ACQUISITION ) H U
L3 15 S7120 S5  .(TURN ON PEN PLOTTER ) H.
L2 0=R L3 P B  .. S5 SW PI=R.91 JG3
0=R L4 P B=F ..F- S5 SW PI=R.91 JG4
JU2
```

Test 3a.



Test 3b.

00000	00002	00005	00008	00011	00013	00016
00022	00024	00027	00029	00032	00035	00037
00042	00044	00047	00049	00051	00053	00055
00059	00061	00063	00064	00066	00067	00069
00071	00073	00075	00075	00076	00076	00077
00078	00079	00079	00079	00079	00080	00080
00079	00079	00079	00078	00078	00077	00076
00075	00074	00073	00071	00070	00069	00067
00064	00063	00061	00059	00057	00055	00053
00049	00047	00044	00042	00040	00037	00035
00029	00027	00024	00022	00019	00016	00013
00008	00005	00002	00002	00002	00002	00000

Test 3c.

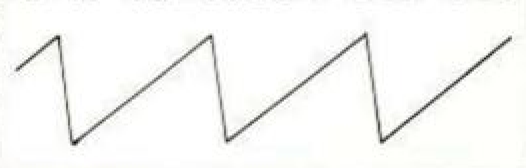


Test 3d.

The results of the test are shown in the trace and it is clear that over the part of the range of the servo used for the test, there is a linear relationship between the input voltage to the transmitter and the rotation produced by the servo.

After producing a sawtooth wave-form, the changes in acceleration necessary to produce a smooth sine wave are a good complementary test of a recorder's abilities and test 3 gives the details of a program to load integer values for a sine wave into the data log before continuing to plot them using the pen recorder. The values for the sine wave were calculated using a programmable calculator and multiplied by 80 so that at sine 90° = 1, the maximum value output to the D-to-A converter is the mid-line value of 175 + 80 = 255.

```
15 S6 S7
L1 1=Y 90=B
L2 B,Y+=? S4 S5.
5 W Y1=Y,164 JG2 JU1
```



Test 2.

The values for 180° only are entered into the data log and the sine wave is plotted by first adding the values in the data log to the base value and outputting the result to the D-to-A converter and then by re-cycling to the beginning of the log and subtracting each value in the data log from the reference value. The trace "B" shows the result I achieved using 90 two-degree increments and the second trace "D" a far better result with 180 values each incremented by one degree.

CONCLUSIONS

- Model radio control using digital data transmission can be used as a stable and effective signal pathway from a microcomputer to a remote device. The range of the transmitter/receiver combination used is in excess of 200yd.
- The mass-produced servos sold for radio control should not be underestimated — the power to weight ratio, for example, is excellent. Each servo costs about £12.50 and the low price is the result of IC technology and clever production engineering.
- The pen recorder described cost around £25 to build, excluding the RC transmitter and receiver, and, even in its crude prototype form, gives useful results. The design is sound and could be tidied up and constructed easily in school workshops or at home.
- The pen recorder will be used in other applications — for example, to plot the changing light intensity during each sweep of the scanning electronic camera and, perhaps, to record the data acquired from a solar panel.
- The next stage will probably involve the start of a program similar to Duncan for the Tangerine Microtan computer and some thoughts about a mobile trolley — could a inexpensive gyroscope be built for navigation using an ordinary DC model motor? How fast does a gyroscope need to rotate to form a fixed reference? Is the weight of the fly-wheel important and what is the speed/weight trade-off?

Further reading

Byte, February 1981, volume 6, number 2, page 44. A computer-controlled tank. Steve Ciarcia.

Byte, July 1980, volume 5, number 7, page 22. Hand-held remote control for your computerised home. Steve Ciarcia.

Dr Dobbs Journal, September 1979, volume 4, issue 8, page 4. An electromechanical household servant. F G Reynolds.

Practical Computing, May 1981, volume 4, number 5. Duncan — a high-level control-orientated interpreter for the Nascom 1. John Dawson.

Practical Computing, volume 3, issue 7. Low-cost printer interface for the Nascom 1. John Dawson.

Byte, January 1978. The brains of men and machines. E W Kent.

FINGERTIPS

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

WHAT CLEVER people seem to have read the first issue of *Your Computer*. Everyone who replied to my challenge for the neatest solution to the Newton-Raphson approximation:

$$\text{New guess} = \frac{(\text{Old guess})^2 + \text{number to be rooted}}{2 \times \text{Old guess}}$$

spotted the deliberate error. If there are still people hammering on their keys trying to make the solution converge properly, then I must apologise.

There were some very snappy answers indeed and there is no doubt that the Casio 501/502Ps would be very well placed to win the Calculator *Le Mans*. The top Japanese team can perform the required four laps in less than 1.3 seconds leaving the sluggish HP-41c/TI-59 combination lagging far behind with a time of more than three seconds.

Of course, this is no true reflection of programming ability, just an admission that some calculators spend more time thinking and keeping their own house in order than others. It leads to a question which I sometimes ask — what type of calculation will a given programmable perform best? Maybe you have some opinion on the matter.

I have always appreciated the speed of the Casios which are excellent machines for any looping program which does not involve excessive amounts of data and program memory. The Casio 501P has 11 independent memories and may store a total of 128 program lines, half of the number available to its big brother, the 502P. This also applies to the five levels of parenthesis possible on the 501.

Apart from this, the major difference between the two is the dubious musical ability of the more expensive version. The very comprehensive program library — which Casio supplies — lists such favourites as *Romance de Amor* which must be saved on to cassette tape before being heard.

This, along with extra program storage on cassette, may be accomplished only with the FA-I adaptor, which is an optional extra. From what I have heard, I would be very surprised to find a Casio number in the Top Twenty.

Personally, the most attractive points about the calculator are its easy-to-use editing procedure, straightforward operation, continuous memory and very clear liquid-crystal display. Definitely a good buy in its price range.

I recently had to solve a problem which was fully suited to the 501P. I wanted to know, for some perverted reason of my own, the probability of 110 events or fewer occurring in a system where the mean number of events was 229 and governed by Poisson statistics.

What this really means is that a discrete, i.e., integer only, variable *X* will have a probability of occurrence which follows the distribution:

$$\text{Probability of } x = \frac{(\text{Mean value}(\mu))^x e^{-\mu}}{x!}$$

If you are not fond of even simple mathematics, do not gulp — just pretend that the next few sentences are not really there. This distribution mimics reasonably well a distribution of similar events which occur independently of one another. For instance, I might say that the number of Commodore P50s bought in a London shop per week will follow this distribution.

In fact, Poisson showed that it really worked by looking at the number of Cavalry Officers kicked by their horses during the Napoleonic Wars. Clearly, the problem is to calculate the sum:

$$\sum_{X=0}^{110} \frac{(229)^x e^{-229}}{x!}$$

As ever in programming, the aim is to find a neat and concise algorithm to solve the problem. Instead of diving in head first, note that a little mathematical dexterity, i.e., fiddling, proves very handy. I have yet to see a calculator which does not balk at numbers like 110! and $(229)^{110}$. One of the easiest paths to follow is to note Stirling's Approximation:

$$N! = \sqrt{2\pi N}\, N^N \exp(-N)$$

which is a good approximation to the factorial function for $N>20$. Now we just have to compute the more reasonable:

$$\frac{\left(\frac{229}{110}\right)^{110} \exp(-119)}{\sqrt{220\pi}}$$

$$\left[1 + \frac{110}{229} + \frac{110(109)}{(229)^2} + \ldots\right]$$

All of the numbers dealt with by the calculator are now reasonably small compared to 9.9999exp99. The subroutine I wrote to evaluate the sum in brackets was:

```
01 LBL 1
02 MRS     (Memory recall)
                Set to 1
03 X
04 MR 0    Set to 110
05 ÷
06 MR 1    Set to mean
07 =
08 MIN 6   (Store command)
09 +
10 MR 8    Set to 1
11 =
12 MIN 8
13 DSZ     Decrement register 0
           by one and skip next
           line if equal to zero
14 GTO 1
15 X
16 MR 9    Contains value of
           quantity outside
           brackets.
17 =
```

The full calculation takes 22.5 seconds with an answer of about 1.6×10^{-18}. So we conclude that the likelihood of 110 events or fewer is small. *Your Computer* now challenges the owners of any other commercially available calculator to beat this time. A free year's subscription to the magazine to the first victor — but I am confident that our money is safe.

How many of you know exactly what your calculator does when it reaches a GOTO or GTO command? It is really very easy to find out, so I shall leave that to you. For instance, the Casio 501 will store the label number given and step backwards toward the beginning of the program searching each line for the appropriate label.

If it cannot find it before the program heading, it will return to the initial command and continue the search in the opposite direction. On the other hand, a TI-58 or TI-59 will immediately jump back to the heading and search its way through the program.

Knowing this is very helpful to fast and efficient calculating. Note that both types of looping enable one to use the same label in the same program more than once.

For interest, I have compared the speeds with which some calculators perform the most basic DO loop of the form:

```
LABEL X
Y = Y-1
IF Y = 0 SKIP NEXT LINE
GOTO X
STOP
```

Table 1.

	HP-25	Casio 501P	TI-58C
25 cycles	8.3s	0.9s	4.9s
100 cycles	31.8s	2.9s	19.1s
1,000 cycles	Fell as loop	25.7s	Fell as loop

The conclusions are obvious. You can investigate further the length of time your machine takes to perform various functions and how long it takes to find the label by inserting extra lines into the Do Loop. Still, let us not become too neurotic about calculator speed as other things are more important.

After all, we do have three score years and $10 - 2.2 \times 10^9$ seconds — of available CPU time, so what does the odd second really matter? Unless, that is, you are a masochist like M V Ellis of Salford who wrote to tell me that he has a very useless program which displays the squares of all the integers from 1 to 10,000 and calculates their sum. His TI-57 takes more than seven hours. If this is a calculation you perform every day, Mr Ellis, I strong advise that you invest in a Casio.

(continued on next page)

JARGON

■ LCD display

The displays of all but the most recent calculators are based on the figure-of-eight lay-out for each digit, driven by internal integrated circuitry. Two major types of element are used in calculators. Older generations have segments of light-emitting diode, LED, which produce light by non-thermal means requiring only low voltage with small current consumption. The light is produced in the semiconductor junction by a process known as electroluminescence which tends to produce light at longer wavelengths, hence the characteristic red colour. This type of display is gradually being replaced by the liquid-crystal display, LCD. A liquid-crystal exhibits large-scale molecular orientation effects and has similar properties to a solid crystal — for example, its interaction with polarised radiation. Although it produces no light, its interaction with incident light makes it visible. LCDs require even lower current drain than LED displays and the problems of distinguishing numbers in bad lighting conditions are gradually being overcome.

■ Algorithm

A word used by computer buffs to denote the sequence of mathematical operations used in solving a given problem.

(continued from previous page)

In the next issue, when we become a monthly magazine, I hope to tell you who really did win last issue's competition and how to make your loops even faster. Also, for those of you who found this month's menu all too trivial, I will broach some advanced manoeuvres on the HP-41. Sinclair and Commodore owners do not despair, I have not forgotten you.

One final bedtime teaser. Why does the time taken for each cycle marked in table 1 appear to decrease with the number of cycles performed? Happy insomnia.

READERS' PROGRAMS

I WOULD like to introduce two readers' programs this month. John Murrell of Rugby has trained his HP-25 to play, of all things, Noughts and Crosses:

```
01 RCL6      Recall memory 6
02 R/S
03 STO 1     Store in memory 1
04 2
05 ÷
06 ENTER     (R.P.N.)
07 INT       Take the integer
             part
08 X=Y
09 GTO 13
10 2
11 X<Y
12 8
13 STO 2
14 R/S
15 STO 3
16 RCL 7
17 RCL 2
18 —
19 X≠Y
20 GTO 49
21 RCL 1
22 +
23 RCL 0
24 —
25 CHS       Change sign
26 STO 4
27 R/S
28 RCL 7
29 RCL 4
30 —
31 X≠Y
32 GTO 49
33 5
34 RCL 4
35 RCL 2
36 +
37 X=Y
38 GTO 42
39 RCL 0
40 —
41 GTO 06
42 RCL 1
43 —
44 ABS
45 I
46 X≠Y
47 7
48 GTO 00
49 CHS
```

The squares are coded as follows:

8	1	6
3	5	7
4	9	2

To play, enter:

```
5 STO 6
10 STO 7
15 STO 0
          R/S (HP has first move)
Your move R/S (HP has second
          move)
```

etc., until the outcome is decided — indicated by the negative sign. I make no claims for the sanity of your opponent.

The following is a prime-number generator for the Sinclair Cambridge by D R Haslam. Starting with any odd integer, n, the program displays primes. Odd integers which are not prime are not displayed, but instead, the smallest prime factor of the number is displayed.

```
00 +        18 3
01 (        19 =
02 —        20 sto
03 +        21 #
04 rcl      22 2
05 —        23 =
06 ▼        24 ↓
07 gin      25 ▼
08 0        26 goto
09 2        27 0
10 =        28 0
11 ▼        29 #
12 gin      30 2
13 2        31 +
14 9        32 rcl
15 rcl      33 —
16 stop     34 sto
17 #        35 )
```

To execute:

- Store 3 in the memory.
- Either press Run with 3 still in the display, or enter some other odd positive integer, then press Run.
- Repeatedly press Run. A new number, either a prime or the lowest prime factor of a non-prime will be displayed.

The program is rather slow, and becomes progressively slower as n increases.

Finally, here is a request from Billy Wadsworth who writes: Since you seem to have an interest in numerical analysis, perhaps you could help with another small problem I have. I use an HP-9830 at work to analyse structures. For a recent beam problem, I translated a routine by Choleski which I had found in a book by Jenkins — *From Algol to Basic.*

The routine is used to solve linear equations taking advantage of their symmetry and band-width. This worked well for the beams, for which the equations have a narrow band-width — ½bw=3 — and contain no included zero elements. However, when I tried the same routine for slabs for which the finite-difference formulation gives a wider band-width — ½bw typically=13 or so — and included zero elements, the routine breaks down with an error 52, —ve number.

The question is: Is the Choleski routine unsuitable for this purpose? Also can you point me to another more robust routine? Even better, can you tell me where to find — or even publish in the magazine — a suitable routine coded in Basic? ■

MAPLIN for ATARI

ATARI

AUTHORISED DEALER

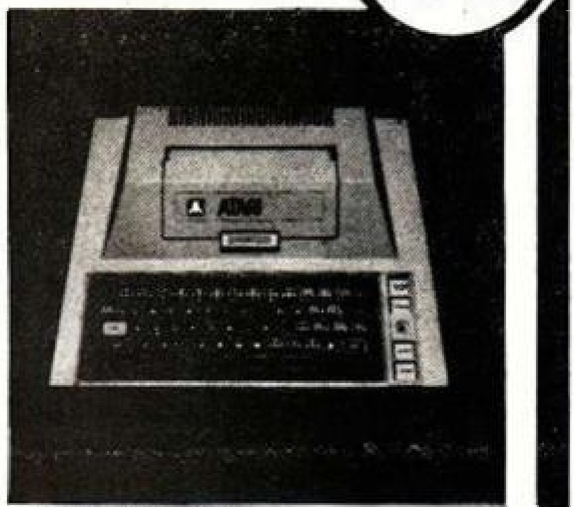
The World-beating ATARI PERSONAL COMPUTERS

3 consoles available

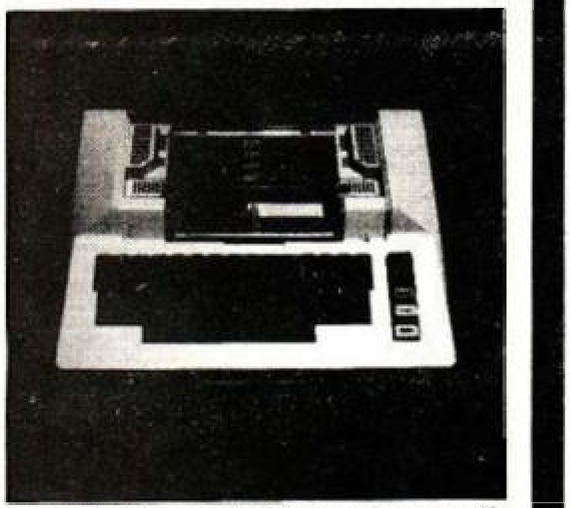
Atari 400 with 8K RAM (AF03D) £295

Atari 400 with 16K RAM (AF36P) £340

Atari 800 with 16K RAM (AFO2C) £625
(expandable to 48K)



Atari 400 Console



Atari 800 Console (with cover removed)

All consoles when connected to a standard UK colour (or black and white) TV set can generate the most amazing graphics you've ever seen.

Look at what you get:

* Background colour, plotting colour, text colour and border colour settable to any one of 16 colours with 8 levels of illuminance!
* Video display has upper and lower case characters with true descenders, double and quad size text and inverse video.
* 57-Key keyboard (touch type on Atari 400) and four function keys.
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Atari 410 Cassette Recorder (AF28F)	£45
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16K RAM Memory Module (AF08J)	£65

MUCH MORE FOR ATARI COMING SOON

SOFTWARE

Lots and lots of amazing software for Atari available during June 1981.
★ Word Processor ★ VISI-CALC ★ ADVENTURE GAMES ★ Arcade Games ★ Trek Games ★ ASSEMBLER & DISASSEMBLER ★ FORTH ★ Teaching ★ 3D GRAPHICS ★ Character Set Generator

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Atari 810 Disk Drive
Disk Operating System
Documentation
Interconnecting Leads
And everything in "Look at what you get" list.
Can any other computer on the market offer all this at anything like this price?

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12½ x 8in. drawing board. Drawing on board is reproduced on TV via Atari with 32K ROM and Disk Drive. Closed areas may be filled in with one of 3 colours. Text may be added in any one of 4 fonts. Paint brush mode: select size of brush and paint away. Air brush mode: shade in your drawing – colour and density is up to you. Plus many more features. S.a.e. for price and further details.

Demonstrations at our shops from June 9th 1981. See Atari at 284 London Road, Westcliff-on-Sea, Essex. Tel: (0702) 554000 and at 159-161 King St., Hammersmith W6. Tel: 01-748 0926

MAPLIN

Maplin Electronic Supplies Ltd
P.O. Box 3, Rayleigh, Essex.
Tel: Southend (0702) 552911/554155

Note: Order codes shown in brackets. Prices firm until November 14th 1981 and include VAT and Postage and Packing. (Errors excluded.)

• Circle No. 143

RESPONSE FRAME

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell and Trevor Sharples will do their best to answer your queries. Please include only one question per letter and mark them "Response Frame".

VIC CHARACTERS

I am very interested in the Commodore Vic-20 but was disappointed to find it only allows 23 characters per line. Please could you advise if and when it will be upgraded to 40 characters a line and also an approximate price?

G Howell, Kiberick, Wood Village, Newgale.

THERE WILL be a replacement ROM available in due course to bring the graphics up to standard Pet resolution, but as usual Commodore is playing its cards close to the corporate chest, and we can't discover when this will be. Replacement ROMs tend to be in the £15-£30 range.

CPU VARIETY

I am thinking of buying a personal computer and I hope you can guide me to a suitable model. Preferably I should like a British one. It would be used to play games to begin with, then later to learn programming and to run my own programs, or those printed in magazines. I have a number of questions.

What is the difference in the various CPUs, e.g., 6502, Z-80 etc., and what does each do that the others do not?

THE differences in chip architecture are not relevant to the kind of things you need to know to buy a computer at your present stage. The different chips have different processing times, and are accessed directly in different ways, but this information cannot help you choose a first computer.

INTERPRETERS

What is the advantage of having a Basic interpreter in EPROM rather than ROM — for example, the Tangerine options?

EPROMs ARE simply temporary ROMs — although it takes some work to erase them — and, in practice, there is no difference when you're buying encoded data as you are in a ROM whether the information is stored permanently or almost permanently.

READ AND DATA

What is the advantage of Read and Data statements, and why does the Sinclair not have them?

READ AND Data are very useful ways of storing information within a program listing to be used when a program is running. They can be emulated in many ways, such as storing information in a string, or in a REM statement. The Sinclair ZX computers do not have Read/Data — neither does the Acorn Atom — because this facility uses plenty of ROM space, and when the monitor is limited, not everything can be offered. In the case of the ZX-81, the planned Read/Data was dropped to allow a printer to be driven by the computer.

DEEK, DOKE

I have read the explanation of Peek and Poke in the first issue of *Your Computer* and found it enlightening. Following on from that, can you tell me what the Nascom Deek and Doke do?

DEEK AND Doke are double-length versions of Peek and Poke. Instead of altering one byte, or interrogating one byte, Deek and Doke deal with two bytes at a time. For example Doke A, B is equivalent to

```
POKE A, B − INT(B/256)*256
POKE A+1, INT (B/256);
```

and Deek A is equivalent to

```
PEEK A+PEEK (A+1)*256.
```

This is because any variable which has a greater range of values than ±127 needs two bytes to store it and, therefore, two bytes must be altered or interrogated.

BUYING NOW

Finally, I have attended two seminars run by international computer firms and took their tests. I failed both. Do you think that I should save my money, wait for an idiot-proof machine, or go ahead and buy one and see if I like it?

BUY ONE. There are always better computers on the way. If you wait for the right one, you'll never buy, and will therefore deny yourself the immense pleasure of having a machine. Buy one now, and in due course, a year or two, you'll be ready to buy a new one, and will have a good idea of which one to buy then, but don't wait. Anyway, if you can frame the kind of questions you've asked in this letter, you could control a computer standing on your head.

The questions were from W Jackson, Chesteron, Cirencester.

LOADER LOAD

I was having trouble Loading and Saving with my Acorn Atom and I noticed a letter from someone with a similar problem in the first issue of *Your Computer*. I have a Prinz TR-225 tape recorder which cost £16.95. The problem was solved when I added a large resistor in series with the Atom output, 100kohm if using "aux" input or 1megohm if using "mic" input. The problem seems to be caused by too much output from the Atom. Information for this is provided in the kit builders' manual, page 15.

James L Ashton.

THANKS JAMES, we'll pass the information on, and hope it will be of use to other readers.

BASIC CHOICE

I am finding it very hard to find a suitable Basic computer for myself, since most are well out of my spending limit — which is anything less than £400. That's why I am asking you if you could give me a list of computers and software, so I will be able to decide which one to buy.

Anil Jolley, Heston, Middlesex.

CHOOSING the right computer is always a hard decision. You can easily become caught in the "for a few pounds more I can buy this computer" trap. At the moment, your choice is limited if you are looking at Basic computers at less than £400, but there are some very good computers in this price range. Starting at the bottom you have the Sinclair ZX-81, £70, available in ready-built or kit form, but unless you are a complete beginner it is probably not worth considering. For around double the price, the choice is wider: the Acorn Atom and the UK101 — both at about £150. Both are expandable into full disc/printer systems and both have a good degree of software support. They both are supplied either as kits or fully-built and tested, but the Atom is complete with case whereas a case is extra for the UK101. Raising the price a little further to between £200 and £300 brings the Ohio Superboard and Nascom 2. These, too, are expandable systems with a good deal of software support. At the top of the £400 price range falls the TRS-80 and the less expensive Video Genie which is fully TRS-80 Level II software compatible as well as Tangerine's Micron and the old faithful, the Commodore Pet. The Pet and TRS-80/VG have an excellent range of software available, while the software available for the Micron is steadily growing. The best way to decide which micro is for you is to go into a computer shop and try using them for yourself — hands-on experience is always better than written advice.

COMPATIBILITY

I have several questions about the Commodore Vic. Will the largest screen, 40-by-24, version of the Vic be compatible with the Pet in all respects except screen size? When will it be available? Which version of Basic will it use — 2.0, 3.0, 4.0? Most of my machine-code programs use the Basic-4.0 ROMs. Would it be possible to upgrade from small to large-screen Vic simply by adding a chip, costing, say, £30 to £40? Have you any details on the new Sinclair machine in the pipeline which you mentioned?

James Turner, Chesterfield, Derbyshire.

SLOWLY, slowly. The Vic is barely out and you already want to know what will replace it. Commodore tells us that most of your questions are jumping the gun because a large-screen Vic has not even been designed. Commodore thinks that when the design is completed — and we were given no idea when that would be — it will have a similar format to the Pet 4000 series and will use Basic 2.0. Regarding the "new Sinclair machine in the pipeline": Sinclair Research is in a "we won't confirm or deny" mood which suggests that it may have something on the way. We guess a machine costing around £100 which will use the same Basic as the forthcoming Acorn Proton, to be released around November — but it is only a guess.

S-100 BOARDS

I wish to use some of the many S-100 bus boards which are currently available on the market in connection with my Microtan 65. My problem is that I cannot find a firm which sells such a device. If you know of one, would you tell me its name and address and if there isn't such an enterprising business in existence would you direct me to books which might have some bearing on the subject? Finally, I would like to say that if the next issue is as good as the first, the magazine will be a success.

R Bavington, Walthamstow, London E17.

THANKS FOR the comments on the magazine. You have to make your own S-100 bus. The Institute of Electrical Engineers can furnish you with the specifications, and should be able to help you with related literature.

SILICON TIPS

I'm reading the June/July issue of *Your Computer* and look forward to more. Could you please give me a reference to a book or technical papers explaining the working of LC display, silicon chip, electronic components used in them, how desk calculators and digital watches work? My enquiries at local libraries have yielded nothing.

F G H Lewis, Witley, Godalming.

THERE HAVE been some articles on LCDs recently in *Practical Electronics* which could be of interest. The Central Reference Library in central London keeps back issues of many publications in electronics and computing, and you can go there and inspect the back issues. ■

Software File gives you the opportunity to have your programs, ideas or discoveries published. We will accept contributions for any personal computer but will group programs for like machines together in the file. Please double check your listings before sending them. Mark your letter clearly for *Your Computer.* We will pay £6 for each contribution published.

Point to point

Mike Howard, Lydney, Gloucestershire.

ZX-81

HERE ARE three points new users of the ZX-81 might find useful. I am using the 8K Basic ROM on a ZX-80 but all programs and points will apply to both the ZX-81 and the uprated ZX-80.

Firstly, it disappointed me that plot and unplot only allow a single character to be plotted: other Basics allow a third argument which allows any of the character set to be plotted — as, for example, on the RML 380-Z.

A brief look at the variables table in the manual shows that 16398, 16399 is the address of the current print position so that this less one is the address of the last plotted point.

Poking this with the code for a different character has the desired effect of replacing the plot square with any character required. Thus, assuming you have defined X and Y:

```
10 PLOT X,Y
20 POKE(PEEK(16398) + PEEK(16399) × 256-1),23
```

will plot an asterisk. The Poked graph is coarser than the original but for overlaying two scattergrams, for example, where contrast is important, it can be an ideal way of displaying data. Do not forget the —1 in the Poke or you will crash the Basic.

A real plethora of Hex to decimal conversion programs for the ZX-80 prompted me to write the following pair of programs for the ZX-81 which, taken together, will enable anyone to decode the ROM easily or help in producing machine code software.

Hexmon will produce tabulated addresses and contents in Hex of any eight bytes of memory. The start address if input first but after that, each Newline will give the subsequent eight bytes. Entering a new address instead of the Newline displays the eight bytes starting at that address, so the user can jump round in memory.

Hexcon will convert any positive Hex number into decimal and will also calculate relative jumps, as an adjunct to Hexmon, it has been very useful to me. It first asks whether you want a jump or a conversion and then invited you to enter the Hex code which it will convert to an absolute number or a decimal-signed integer for jumps. All strings printed are inverse characters.

```
10 REM HEXMON C M HOWARD 1981
11 GOTO 70
12 LET S=VAL D$
13 CLS
14 FOR I=0 TO 7
20 LET A=S+I
30 GOSUB 100
40 LET A=PEEK(S+I)
50 GOSUB 100
60 NEXT I
70 PRINT AT 20,0;""HEXMON"
ENTER NL OR ADDRESS"
80 INPUT D$
90 IF D$<>"" THEN GOTO 12
95 LET S=S+I
98 GOTO 13
100 DIM A$(4)
110 FOR J=4 TO 1 STEP-1
120 LET A$(J)=
CHR$((A-16*INT(A/16)+28))
130 LET A=INT(A/16)
140 NEXT J
150 PRINT A$
160 RETURN
```

```
5 REM HEXCON C M HOWARD 1981
10 PRINT AT 20,0;""HEXCON" -
JUMP OR CONVERT?(J/C)"
14 INPUT B$
15 IF B$="S" THEN STOP
16 CLS
17 PRINT AT 20,10;"ENTER HEX"
18 INPUT A$
19 CLS
20 IF B$="J" THEN GOSUB 30
22 IF B$="C" THEN GOSUB 40
25 GOTO 10
30 GOSUB 90
35 IF A>=128 THEN LET A=A-256
36 PRINT AT 10,10; "JUMP IS";A
37 RETURN
40 GOSUB 90
41 PRINT AT 10,10;B$;HEX GIVES"
;"AT 11,10;A; "DECIMAL"
42 RETURN
90 LET A=0
95 LET B$=A$
100 LET
A=A+(CODEA$-28)*16**(LENA$-1)
110 LET A$=A$(2TO )
120 IF LEN A$=0 THEN RETURN
130 GOTO 100
```

Complete music

Robin Arlott, Seaford, East Sussex.

ZX-80

MY PROGRAM ALLOWS one to input the notes directly from a sheet of music with their appropriate length and pitch to form tunes of up to 100 notes long. The program can be altered for tunes longer than 100 notes.

The notes are input as C F BF — B flat — AS — A sharp — and so on. The length of note is input as "0" "1" "1." and so on for semi-quaver, quaver, dotted quaver and so on. Crotchets are taken as standard and input by pressing Newline only.

The pitch and timing of a tune, once input, can be raised or lowered, made faster or slower, either uniformly for all notes in the tune, or for individual notes. The program compensates for the variation of length of note with pitch automatically so that high notes last as long as low notes — see the factor 20×C/Y in lines 80/92.

The number of times a tune is played is determined by the loop at 105; the program can be interrupted by pressing Space at the end of any recital.

A surprising feature of the program is that it can be played directly on to any transistor radio or music centre without any wired connections, provided the ZX-80 is reasonably near the radio. The pitch at which the tune is played can be varied by adjusting the tuning of the radio.

The quality of the sound is improved if the TV set is switched off, though of course the ZX-80 must remain plugged in. With several radios nearby at the same time, one can obtain striking effects — for example, a haunting performance of *Shenandoah.*

The machine-code routine used is that suggested by David Harris but the overall program has been developed very considerably beyond the rather brief program he offered.

The program will accept any tune containing up to 100 notes. If more is wanted, line 1010 should be amended to enlarge the B

(continued on next page)

(continued from previous page)

array. The tune will be played three times by the loop at line 105 which can also be altered. The program calls first for the number of notes in the tune and then for each note and its length separately.

The pitch or length of any note can be altered by command. For example:

LET B(35) = F or B(36) = 800

Odd numbers are notes and even numbers lengths of notes. The pitch or length of all the notes in a tune can be changed uniformly by using GO TO 13 and then input S=0 for changing length and S=1 for changing pitch.

The variable T then input increases all values by 1/3 — if −3 is input for example — and reduce by 1/3 if 3 is input; if the values are just to be printed out without alteration, give T as 3000 or larger. Use Continue for a long tune.

The program sets out, at lines 42/44, exactly how length and pitch are to be input, for each note. Note particularly that all values are for the octave of middle C. Notes in higher or lower octaves can be input by using C/2 or C×2, F/3 or G×3 giving respectively higher and lower octaves.

If the music has a dotted note, the "." should be input along with the appropriate length indication, e.g., as "1.". To repeat the tune after alterations, use GO TO 105.

```
10 GO SUB 1000
12 GO TO 20
13 INPUT S
14 INPUT T
15 FOR J=0 TO X
16 IF (J/2)x2=J THEN LET
B(J+S)=B(J+S)-(B(J+S)/T)
17 IF (J/2)x2=J THEN PRINT
"B(";J+S;")";B(J+S)
18 NEXT J
19 STOP
20 LET C=180
21 LET D=160
22 LET E=144
23 LET F=135
24 LET G=120
25 LET A=108
26 LET B=96
27 LET CS=170
28 LET DS=152
29 LET FS=128
30 LET GS=114
31 LET AS=102
32 LET DF=CS
33 LET EF=DS
34 LET GF=FS
35 LET AF=GS
36 LET BF=AS
37 LET L=540
38 PRINT "HOW*MANY*NOTES?"
39 INPUT N
40 LET X=Nx2
41 CLS
42 PRINT "INPUT*";N;"*
NOTES*EG.*C* DS(D*SHARP)
*AF(A*FLAT)';,,,"FOR*NOTES*IN*
HIGHER*OCTAVE*PRESS ";,;"EG.*C/2*
OR* C/3";,,,;
"FOR*LOWER*OCTAVES*PRESS"
;,;"EG.*Dx2*Ex3*ETC."
43 PRINT
44 PRINT "FOR* LENGTH,
AFTER*EACH*NOTE* PRESS"
;,;"SEMI-QUAVER:0" ;,,,;"QUAVER:
1";,,,;" CROTCHET : NEWLINE*
ONLY" ;,,; "MINIM:2"
;,,,,;"SEMI-BREVE:4" ;,,,;
"DOTTED*NOTES: *."
45 FOR J=0 TO X-1
50 IF (J/2)x2=J THEN LET B(J)=L
60 IF B(J)=L THEN GO TO 94
65 INPUT Y
70 LET B(J)=Y
75 INPUT Q$
80 IF Q$="0" THEN LET
B(J-1)=(L/80)x(20xC/Y)
82 IF Q$="1" THEN LET
B(J-1)=(L/40)x(20xC/Y)
84 IF Q$="2" THEN LET
B(J-1)=(L/20)x2x(20xC/Y)
86 IF Q$="3" THEN LET
B(J-1)=(L/20)x3x(20xC/Y)
88 IF Q$="4" THEN LET
B(J-1)=(L/20)x4x(20xC/Y)
89 IF Q$=""  THEN LET
B(J-1)=(L/20)x(20xC/Y)
90 IF Q$="1."THEN LET
B(J-1)=(Lx2/60)x(20xC/Y)
91 IF Q$="." THEN LET
B(J-1)=(Lx3/40)x(20xC/(Yx2))
92 IF Q$="2."THEN LET
B(J-1)=(L/20)x3x(20xC/Y)
94 NEXT J
95 CLS
100 LET B(X)=0
105 FOR K=1 TO 3
110 LET Z=USR(P)
115 NEXT K
120 PRINT "ANOTHER*
TUNE?*PRESS*Y"
125 INPUT T$
130 IF T$="Y" THEN GO TO 38
140 STOP
1000 DIM A(23)
1010 DIM B(200)
1020 LET P=2+PEEK(16392)
+PEEK(16393)x256
1100 LET A(0)=2090
1101 LET A(1)=4416
1102 LET A(2)=26
1103 LET A(3)=6425
1104 LET A(4)=6891
1105 LET A(5)=4975
1106 LET A(6)=26394
1107 LET A(7)=-14155
1108 LET A(8)=6675
1109 LET A(9)=7730
1110 LET A(10)=4928
1111 LET A(11)=12826
1112 LET A(12)=16415
1113 LET A(13)=-194
1114 LET A(14)=-45
```

```
1115 LET A(15)=19437
1116 LET A(16)=16414
1117 LET A(17)=30731
1118 LET A(18)=8369
1119 LET A(19)=11259
1120 LET A(20)=-19076
1121 LET A(21)=-4064
1122 LET A(22)=6163
1123 LET A(23)=218
1200 RETURN
```

Teaching aid

ZX-80

J J Bartolo

I COMPILED this program to be used in conjunction with a ZX-80 with expanded memory as a teaching aid for children who are taking their first steps in arithmetic. Although it has been presented to deal with simple addition, it can be altered easily for simple subtraction, division and multiplication.

The statements entered throughout the program, such as in line 1040, "that was not too good", are only guides and any relevant comment can be entered provided there is sufficient memory space available.

When the program is run, the computer asks you to enter two numbers. It will then pick two random numbers within the ranges one to the numbers entered. Then it adds these numbers together and displays the correct answer with three random alternatives and randomly labels them A, B, C and D in typical multi-choice format.

The child now takes over and is asked to choose the correct answer. If he or she chooses correctly, the score is incremented and a new sum generated and displayed. Of course, if the child should choose an incorrect answer, the wrong score is incremented, displayed and the child invited to try again. The sum will remain unaltered until a correct answer is found.

A total score with 10 correct answers more than incorrect ones is rewarded by the remark, "These seem to be easy for you". The computer is then instructed to multiply the numbers initially entered by two, thus making the sums slightly more difficult. After another successful batch of 10 answers correct more than wrong ones, the numbers are again multiplied by two. This sequence continues until 50 correct answers more than wrong ones are attained.

The program is then stopped and a message given. If desired, new starting values can be entered so that the child can continue. If the child has difficulty in choosing the correct answer as a result of being uncertain of the sums and has a score of 10 incorrect answers more than correct ones, the numbers entered intially are divided by two making the sums simpler.

If the child is still unsuccessful, the program is stopped and a message given. When the program is stopped by pressing the "S" key, the computer sums up the child's progress and stops the program.

```
5 REM TEACHING AID by J. J. Bartolo
10 PRINT, "ADDITION"
15 PRINT, "--------"
17 LET J=0
19 LET W=0
20 LET V=0
23 PRINT
25 PRINT "ENTER FIRST NUMBER"
27 PRINT "THEN PRESS NEWLINE KEY"
30 INPUT Q
32 CLS
35 PRINT "PLEASE ENTER SECOND NUMBER"
37 PRINT "THEN PRESS NEWLINE KEY"
40 INPUT M
42 CLS
44 IF Q>16383 OR M> 16383 THEN GO TO 1300
45 LET F=RND(Q)
47 LET K=RND(M)
50 LET Z=F+K
53 LET L=RND(4)
55 IF L=1 THEN GO TO 65
57 IF L=3 THEN GO TO 90
60 IF L=4 THEN GO TO 110
63 IF L=2 THEN GO TO 75
65 LET A=Z
67 LET B=Z+RND(2)
70 LET C=Z+RND(3)
73 LET D=Z+RND(10)
74 GO TO 200
75 LET D=Z
77 LET A=Z+RND(3)
80 LET B=Z-RND(2)
83 LET C=Z+RND(10)
85 GO TO 200
90 LET B=Z
95 LET A=Z+RND(10)
100 LET C=Z-RND(3)
105 LET D=Z-RND(2)
107 GO TO 200
110 LET A=Z-RND(3)
120 LET B=Z-RND(10)
130 LET D=Z-RND(2)
140 LET C=Z
200 IF A=B OR A=C OR A=D OR B=A OR B=C OR
B=D OR C=A OR C=B OR C=D OR D=A OR D=B OR
D=C THEN GO TO 500
203 PRINT "ADD", "NO. CORRECT";,J
205 PRINT F
207 PRINT K;, "NO. WRONG"; ,W
210 PRINT
215 PRINT "CHOOSE THE ANSWER YOU"
220 PRINT "THINK IS CORRECT"
225 PRINT
230 PRINT
235 PRINT "A.."; A, "B.."; B, "C.."; C,
"D..";D
240 PRINT
245 PRINT, "KEY IN YOUR CHOICE"
250 PRINT "AND PRESS NEWLINE KEY"
255 PRINT
260 PRINT
265 PRINT,, "KEY .S. TO STOP"
268 INPUT X$
270 CLS
280 IF X$="S" THEN GO TO 1035
285 IF X$="A" AND L=1 THEN GO TO 400
290 IF X$="B" AND L=3 THEN GO TO 400
300 IF X$="C" AND L=4 THEN GO TO 400
305 IF X$="D" AND L=2 THEN GO TO 400
310 PRINT, "WRONG"
315 PRINT, " - - - - -"
320 LET W=W+1
330 IF J=0 AND W=10 OR W=J+10 THEN GO TO 701
340 IF W=J+20 THEN GO TO 1065
350 GO TO 200
400 PRINT
410 PRINT, "CORRECT"
420 PRINT, "- - - - - - -"
430 LET J=J+1
440 IF 10=J-W AND V=0 OR 20=J-W AND V=1 OR
30=J-W AND V=2 OR 40=J-W AND V=3 THEN GO TO
1100
450 IF J=W+50 THEN GO TO 1200
460 GO TO 45
500 IF L=1 THEN GO TO 600
510 IF L=3 THEN GO TO 620
520 IF L=4 THEN GO TO 640
530 IF L=2 THEN GO TO 670
600 LET B=B+1
605 LET C=C+2
610 LET D=D+3
615 GO TO 200
620 LET A=A+1
625 LET C=C+3
```

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```
630 LET D=D+2
635 GO TO 200
640 LET D=D+1
645 LET A=A+2
650 LET B=B+3
660 GO TO 200
670 LET A=A+3
680 LET B=B+2
690 LET C=C+1
700 GO TO 200
701 LET Q=Q/2
720 LET M=M/2
730 PRINT "THESE SEEM TOO HARD FOR YOU"
740 PRINT "TRY SOME EASIER ONES"
1030 GO TO 45
1033 PRINT
1035 PRINT
1037 PRINT
1040 IF J=W THEN PRINT "THAT WAS NOT TOO
GOOD",, "TRY SOME MORE."
1050 IF J>W+10 THEN PRINT "WELL DONE."
1055 IF J+10=W THEN PRINT "I THINK YOU
SHOULD TRY SOME", "EASIER ONES."
1056 IF J<W+10 THEN PRINT "YOU NEED MORE
PRACTICE"
1058 GO TO 1222
1065 PRINT "I THINK YOU SHOULD GET SOMEONE"
"TO HELP YOU",,,,"ASK THEM TO PROGRAM ME
FOR", "EASIER SUMS."
1070 PRINT
1075 GO TO 1222
1100 PRINT "THAT SEEMED TO BE EASY"
1102 IF Q*2>16383 OR M*2> 16383 THEN GO TO
45
1103 PRINT "FOR YOU, TRY THESE:-"
1105 LET V=V+1
1110 LET Q=Q*2
1120 LET M=M*2
1130 GO TO 45
1200 CLS
1205 PRINT "YOU HAVE DONE VERY WELL"
1210 PRINT "I RECOMMEND A HARDER PROGRAM"
1215 PRINT "BE TRIED"
1222 PRINT
1225 PRINT "YOU HAVE SCORED:-"
1227 PRINT ,J; "CORRECT"
1230 PRINT
1240 PRINT ,W; "INCORRECT"
1250 PRINT
1257 PRINT
1258 PRINT "OUT OF A POSSIBLE"; J+W;
"CORRECT","ANSWERS."
1260 PRINT
1265 PRINT "THE FINISHING VALUES ARE:-"
1270 PRINT
1276 PRINT,, "FIRST NO. ";Q
1280 PRINT,, "SECOND NO."; M
1285 STOP
1300 PRINT "PLEASE ENTER SMALLER NUMBERS."
1303 PRINT
1304 PRINT "YOU HAVE ENTERED "; Q; "  AND
"; M
1305 PRINT
1310 GO TO 25
```

Sketch-pad

Eric Deeson,
Highgate, Birmingham.

ZX-81

THE PROGRAM runs in 1K. However, more memory is needed for sophisticated designs using most of the screen. A three-character input is expected during each loop — or "S" to stop. The first is any keyboard character or symbol; the second should be R, D, L or U; the third must be a number between one and nine inclusive.

Newline is pressed, the cursor moves to a new position — right, down, left or up by the input number of spaces — and leaves the first character behind. When the design is finished — any combination of symbols giving a picture, sketch, graph or map — input "S". This gives removal of cursor, line 18, and report code, line 19, so that only wanted material is displayed. The design may be Saved on cassette. Line 8 is a mug trap to prevent a crash if Newline alone is input.

```
1  REM ZX81 SKETCHPAD   (under line=inverse video
2  REM ERIC DEESON 810606
3  REM ZX81 (16K BEST)
4  LET X=14
5  LET Y=10
6  PRINT AT Y,X;"?"    (cursor
7  INPUT A$
8  IF A$=""THEN GOTO 7 (mugtrap
9  IF A$="S" THEN GOTO 18 (stop
10 PRINT AT Y,X;A$(1)
11 LET B=CODE A$(2)
12 LET C=VAL A$(3)
13 IF B=58 AND Y-C>=0 THEN LET Y=Y-C
14 IF B=55 AND X+C<32 THEN LET X=X+C
15 IF B=41 AND Y+C<22 THEN LET Y=Y+C
16 IF B=49 AND X-C>=0 THEN LET X=X-C
17 GOTO 6
18 PRINT AT Y,X;" "       (remove cursor
19 PAUSE 40000            (block report code
```

Pools prediction

T Dawson,
Prestwick.

ZX-80

THIS ZX-80 POOLS-prediction program has a bias in favour of the team highest in the league table. To assess its worth, here are the home and away league positions which have resulted in a score-draw on the Australian pools.

```
(H,A)(8,10)(10,7)(3,6)(6,7)(1,4)

(4,11)(12,10)(9,7)(8,3)(1,6)(10,8)

(4,5)(1,2)(5,9)(1,11)(3,4)(11,6)
```

```
1   REM "THIS IS A POOLS PREDICTION PROGRAM"
5   REM "H=HOME TEAM. A=AWAY TEAM POSITIONS
FROM THE BOTTOM OF THE LEAGUE TABLE."
10  INPUT H
20  INPUT A
30  LET HP=INT(RND*H)
40  LET AP=INT(RND*A)
50  IF HP>AP THEN PRINT "HOME TEAM TO WIN"
60  IF HP=AP THEN PRINT "DRAW"
70  IF HP<AP THEN PRINT "AWAY TEAM TO WIN"
80  GOTO 10
```

Child's play

D J Berry,
Caerleon, Gwent.

ATOM

THIS LITTLE program evolved from my three-year-old daughter's insistence on having a game which she could play on my Acorn Atom. What resulted, in fact, is a game which helps develop her counting ability and teaches her to recognise the numbers from one to nine.

A random number of dots — between one and nine inclusive — are generated and scattered randomly over the screen. The child's problem then is to count the dots, identify and press the appropriate key — for seven dots, press key "7". A correct answer is rewarded with a series of warbles and an incorrect one by the "bell" ringing, once for every dot in the screen.

The program should happily fit an unexpanded Atom, and it contains a number of useful ideas. Because this program was written with children in mind, I wanted to be able to read the keyboard directly, thus eliminating the need to tap the Return key. Also, any absurdly incorrect entry, such as typing a letter instead of a number should not crash the program.

This facility is provided, on the Atom, by the monitor routine OSECHO which lives at £FFE6, and the assembler routine in lines 30 to 50 makes use of it. The character read is stored in address £80 until it is subsequently recovered and converted from ASCII code to an integer number in line 140.

A little experimentation showed that each key on the keyboard has a graphics character associated with it. This can be demonstrated by ?£8000=CH"key", where "key" is any

(continued on next page)

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keyboard character. Line 110 uses this method to place single pixel dots randomly on to the screen.

Lastly, to produce the warble, I wrote the routine in lines 180 to 230. Three frequencies are generated successively building up to the highest capable of being generated by Basic on this machine.

The program can be made more fun, once the child has mastered the basics, by including a line which blanks the screen after, say, ½ second; e.g.,

```
125 FOR Q=1 TO 30; WAIT; NEXT Q; P.$12
```

```
10 DIM LL(O), P(-1)
20 P.$21
30 [\READ KEY WITH ECHO
40:LLO JSR £FFE6; STA £80
50 RTS;]; P.$6
60cJ=ABS(RND%9)+1; P.$12
70 ?£8000=£20
80 ?£8001=£20
90 FOR K=1 TO J
100 L=ABS(RND%£1FD)
110 L?£8002=CH"D"
120 NEXT K
130 LINK LLO
140 M=?£80-£30
150 IF M=J GOTOb
160 DO P.$7; J=J-1; UNTIL J=0
170   GOTOc
180bFOR 2 = 2 TO 4
190 FOR T=0 TO 50 STEP S
200 ?£B002=T
210 NEXT T; NEXT S
220 J=J-1; IF J>0 GOTOb
230 GOTOc
```

Tabulation techniques

ATOM

John Meikle,
West Calder, West Lothian.

THE ACORN ATOM has a very small screen, and the problem becomes really acute when trying to print a table using floating-point numbers. I use this routine to enable tables of four or five columns to be printed.

The routine takes a number held in %x and prints it in a field of @characters, to fit in with normal printing, with %@numbers after the decimal point. If the number of characters exceeds the length of the field, the number will be printed in as short a field as possible. As it stands, the program will not print out more decimal places than the FPrint statement, but the following two lines will add extra zeros if required.

```
30046 DO X=X-1;IF Y?X=13 THEN DO
      Y?X=48;X=X+1;UNTIL Y?X=13
30047 UNTIL Y?X=46;X=X+%@+1
```

Neither form of the program will print out more than seven decimal places because higher accuracy can be obtained by using the FPrint statement and it makes the coding easier. Numers smaller than one are printed in the form 0.———. If a number followed by an exponent is preferred, remove lines 30025 and 30055. Large numbers usually printed with an exponent are still printed in this form but with fewer significant figures.

The program is as follows:

```
30000 REM PRINTS A NUMBER IN A FIELD
      WIDTH @ WITH %@ DECIMALS
30005 REM USES @,%@,X,%X,Y,%Y,Z;
      CHANGES %Y,X
30010 REM DIM Z,Y TO LENGTH 16
30015 FIF %@>7 THEN %@=7
30020 %Y=ABS%X+5*10↑-(%@+1)
30025 FIFABS%X<1 THEN %Y=%Y+1
30030 STR %Y,Y
30035 X=0;DO X=X+1,UNTIL X?Y=46
30040 X=X+%@+1
30045 Y?X=13
30050 DO X=X+1;UNTIL Y?X=13 OR
      Y?X=69;$Y+LENY=$Y+X
30055 FIFABS%X<1 THEN ?Y=48
30060 FIF%X<0 THEN
      $Z="-";$Z+1=$Y;$Y;=$Z
30065 X=@-LENY
30070 IFX<0 THEN X=0
30075 $Z="bbbbbbbbbbbbbbbb";REM
      REPLACE b WITH A SPACE
30080 $Z+X=$Y;PRINT $Z;RETURN
```

If a field width greater than 16 is to be used, "Z" should be dimensioned to the greatest field width to be used. The following program illustrates the use of the subroutine. It is concerned with the repayment of a short term loan. The sum borrowed should not be greater than £9999.99.

```
  5 DIMY(16),Z(16);@=8;%@=2
 10 FINPUT"AMOUNT BORROWED"%B
 20 FINPUT"INTEREST RATE PER
    PERIOD"%I
 30 FINPUT"AMOUNT REPAID PER
    PERIOD"%R
 40 PRINT $12"bbPERIODbbbbbINTbbbb
    PAIDbBALANCE";REM b=BLANK
 50 P=0;%P=0;%E=0;%T=0
 60 DO
 70 PRINT P
 80 %X=%E;GOSUB 30000
 90 %X=%P;GOSUB 30000
100 %X=%B;GOSUB 30000
110 P=P+1
120 %E=FLT%(%B*%I+0.5)/100
130 %P=%R
140 %B=%B+%E
150 FIF %P>%B THEN %P=%B
155 %B=%B-%P
157 %T=%T+%P
160 FUNTIL %P=0
170 @=0;PRINT"TOTAL PAID=";
    %X=%T;GOSUB 30000;PRINT'
180 DO PRINT"-";UNTIL COUNT=32;END
```

Symbolic values

MICROTAN

Bob Green,
Bournemouth, Dorset.

THE FOLLOWING program will display graphics, decimal values and symbols on the screen. It was written for the Microtan 65 in Basic and it should be of some interest to those users investigating their own systems using simple Peek and Poke commands.

```
10 FOR CLR=1 TO 16: PRINT:NEXT CLR      :clear screen
20 FOR A=0 TO 255                       :set counter
30 PRINT A                              :output value
40 TUG=PEEK(49136)                      :graphics on
50 POKE 968,A                           :output result
60 POKE 49139,0                         :graphics off
70 FOR B=1 TO 1000:NEXT B               :timer
80 NEXT A                               :repeat
90 END
```

Setting memory size

GENIE

P Crowston,
Leicester.

OWNERS OF TRS-80 and Video Genies may like to know how to set memory size within a Basic program. This is achieved by Poking the required memory size at 16562 (D) MSB and 16561 (D) LSB and start of string store at 16545 (D) MSB and 16544 (D) LSB and then running the program from the next line in the program. The DATA lines in the example contain the program "Opus 1, The TRS-80 concerto from the book *TRS-80 assembly-language programming* . . . The RUN 40 command in line 30 forces Basic to use the new values set by the previous lines and continue from line 40.

The music program was placed at 28672 (D) to allow the extension of the music table for different and longer music. This can be done by Poking memory from 28721 (D) onwards. The first byte is the length of the note and the second byte the frequency value of the note.

```
10 POKE 16561,255: POKE 16562, 111: REM
SET MEM 28671
20 POKE 16544, 205: POKE 16545, 111: REM
SET STRING STORE 28621 (MEM -50)
30 RUN 40
40 DATA 221,33,49,112 ,221,78,0,121,183,
200,221, 70,62,1,1,211,255, 16, 254,
221, 70, 1,62,2, 211,255, 16,254,13,194,
10,112,221, 35,221,35,1, 255,255,33,
48,0, 9,218,42,112,195, 4,112:REM SOUND
PROGRAM
50 DATA 160,144,63,162, 92,172, 96,144,
160,144,64,144, 112, 128, 240,144, 93,
162,91, 173, 96, 144, 224, 107, 72,
95,255, 84, 0,999: REM SAMPLE MUSIC
60 DEFINT A-Z
70 I=28672
80 READ A: IF A>255 THEN 100 ELSE POKE
I,A
90 I=I+1: GOTO 80
100 REM RUN MUSIC PROGRAM
110 POKE 16526,0:POKE 16527,112
120 A=USR(X)
130 FOR I=0 TO 100: NEXT I: GOTO 120
```

Road runner

MZ-80K

Alan Murray,
Caithness.

ROADRUNNER will run on any Sharp MZ-80K. It draws a road on the screen and you have to steer a car through the road without bumping into any barrier. You are given extra time if you exceed 400 metres in the first time interval, and the furthest distance one can manage is about 1km.

The program shows an interesting use of Peeks and Pokes. Poke 10167, 1 switches off the Peek protect on the SP-5025 Basic and is necessary before you can use Peek (17828) to access ASCII values to steer the car. The use of Peek(17828) can be shown by the use of this program:

```
10 GETA$:PRINTPEEK(17828);:GOTO10
```

Now try pressing a key. The other Pokes are used to print the car, and its trail on the screen.

```
10 REM *** ROAD RUNNER ***
20 REM ***
30 REM *** by ALAN MURRAY (14) ***
40 REM ***
50 POKE 10167,1
60 PRINT"■■■■■■■■■■■■■■■■■___________________"
70 PRINT"■■■■■■■■■■■■■■■■ROADRUNNER"
80 PRINT"■■■■■   The object of the game is to steer"
90 PRINT"yourself along a road as far as possiblein the time allowed."
100 PRINT"   The controls are 'A' for left"
110 PRINT"                     'D' for right"
120 PRINT"■■   If you exceed 400 in the first time"
130 PRINT"you will be given extra time."
140 PRINT"■ PRESS ANY KEY TO START THE GAME."
150 GETA$:IFA$=""THEN150
160 PRINT"■";:T1=VAL(TI$):O=TI:R=0
170 FORI=1TO20:PRINTTAB(10);"■■       ■■":NEXT
180 I=10:L=0:G=0:C=15:Y=12:C1=15:S=0:T=17828:M=500:F=53248:W=1/14:U=0.85:Z=0
190 V=F+40*(Y-1):X=V+40
200 K=INT(RND(T1)*8+0.5)
210 GET B$
220 G=PEEK(T):IFG=SGOTO250
230 O=O-2:IFG=68THENC=C+1
240 IFG=65THENC=C-1
250 ON K GOTO 280,270,260,280,280,280,280,280
260 IFL=>0THENL=L-1:GOTO280
270 IFL=<0THENL=L+1
280 IF(I=0)+(I=26)THENL=0:I=I+1-I*U
290 I=I+L:PRINTTAB(I);"■■       ■■"
300 POKEV+C1,46:IFPEEK(X+C)=67THENM=500:POKEV+C1,107
310 POKEX+C,201:C1=C:R=R+1
320 FORJ=1TOM:NEXTJ:M=M*U
330 IFTI-O>336THEN350
340 GOTO200
350 IF(R>400)*(Z=0)THENO=TI:PRINT"■extra time!":Z=1:GOTO200
360 PRINT"__________";:PRINT"time up."
370 PRINT"you travelled ";R;" metres."
380 PRINT"do you wish another game ? Y/N?"
390 GETC$
400 IFC$="Y"THEN160
410 IFC$="N"THEN430
420 GOTO390
430 POKE10167,0
440 PRINT"■":END
```

Graphics entry

UK101

A Hughes,
Sevenoaks, Kent.

OWNERS OF the Superboard and the new Cegmon monitor now have the benefit of cursor controls all over the screen, rather than being limited to the bottom line — although they are still somewhat awkward to use in the CHR$ function.

In the back of the Cegmon manual, a routine is given to allow the direct entry of graphics via the keyboard. The problem with this routine is that cursor-control codes are executed as they are entered, resulting in very fragmented program lines.

This routine was written to co-exist with the Cegmon routine. Graphics characters are entered as the program is typed, representing the cursor controls, but they are then coverted to the actual codes when the program is run. The format is similar to those of the MZ-80K and the Pet.

Once the two routines are entered they are brought into operation by Poke 536,64: Poke 537,2: Poke 538,160: Poke 539,2.

The new controls are as follows:

Code	CRTL–
Line feed	T
Cursor right	R
Carriage return	Y
Cursor home	X
Clear window	N
Clear screen	D

The routine uses the spare RAM from 02AO and two other locations, 0236 and 0237. Both routines are protected from a cold-start.

```
02A0  8D 37 02        STA 0237
  A3  8A              TXA
  A4  48              PHA
  A5  A5 88           STAZ 88
  A7  C9 FF           CMP #FF
  A9  D0 08           BNE A
  AB  68              PLA
  AC  AA              TAX
  AD  AD 37 02        LDA 0237
  B0  4C 9B FF        JMP FF9B
  B3  AD 37 02   A:   LDA 0237
  B6  A2 00           LDX #00
  B8  DD D8 02   B:   CMP(X) TABLE 1
  BB  F0 0D           BEQ C
  BD  E8              INX
  BE  E0 06           CPX #06
  C0  D0 F6           BNE B
  C2  68              PLA
  C3  AA              TAX
  C4  AD 37 02        LDA 0237
  C7  4C 9B FF        JMP FF9B
  CA  BD DE 02   C:   LDAX  TABLE 2
  CD  8D 36 02        STA 0236
  D0  68              PLA
  D1  AA              TAX
  D2  AD 36 02        LDA 0236
  D5  4C 9B FF        JMP FF9B
```

Keyboard scan

ATOM

Nigel Capper,
Wrexham, Clwyd.

THIS ROUTINE, for the Acorn Atom, enables processing to continue while waiting for a key to be pressed. It is very similar to the Inkey statement in Microsoft Basic. The routine is called from Basic by executing Link £21C. If a key is being pressed, its ASCII code is stored in the low-order byte of variable K. If a key is not being pressed then K will equal 255. Note that no storage is required for labels. The printer prints a £ sign instead of a hash symbol.

```
10 P.$21          turn off listing
20 P=£21C         store from £21C
30[ JSR £FE71     scan keyboard
40 BCS P+9        key pressed?
50 JSR P+11       get ascii code
60 STA £032C      low byte of K
70 RTS            return
80 LDA @£FF       no key pressed
90 BNE P-6        store & return
100 PHP           push processor
110 JMP £FEA7     get ascii code
120]              end assembly
130 P.$6:K=0      screen on
140 END           end
```

Request answered

ATOM

J W Comley,
Waltham Cross, Hertfordshire.

IN ANSWER to Derek Haslam's request, *Your Computer* June/July 1981, for a program to show which key is being pressed on the Atom. The following short assembler program may help. Lines 10 to 30 describe how the data is returned, lines 40 to 140 assemble the subroutine and line 150 demonstrates its use.

```
10  REM INKEY SBR
20  REM USES ZZ and P; IF KEY PRESSED ASC11 CODE IS RETURNED IN # AF
30  REM IF NO KEY PRESSED 223 is RETURNED IN # AF
40  DIM ZZ(1),P(-1)
50  P.#21
60  [
70   :ZZ1 PHP;JMP #FEB1
80   :ZZ0 CLD;STX#E4;STY#E5
90  JSR #FE71
100 JSR ZZ1
110 STA #AF
120 RTS
130 ]
140 P.$6
150 LINK ZZ0;P.$?#AF;G.150
```

■

The Sinclair ZX80 is innovative and powerful. Now there's a magazine to help you get the most out of it.

Get in sync



SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn't have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voila! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR$ (9) and CHR$ (265) will produce identical values. In other words, CHR$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Or consider the TL$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you'll find in every issue of **SYNC**. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn't be done before. **SYNC** functions on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We'll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can't be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn't a lot to work with, but it can be stretched much further by using innovative, clever coding. You'll find this type of help in **SYNC**.

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In Hurkle, another game in the charter issue, you have to find a happy little Hurkle who is hiding on a 10 X 10 grid. In response to your guesses, the Hurkle sends our a clue telling you in which direction to look next.

One of the most ancient forms of arithmetical puzzle is called a "boomerang." The oldest recorded example is that set down by Nicomachus in his *Arithmetica* around 100 A.D. You'll find a computer version of this puzzle in **SYNC**.

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The magazine for Sinclair ZX80 users

SYNC

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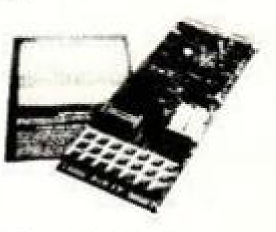
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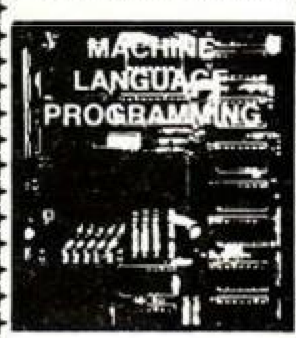
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COMPETITION RESULTS

A number of you seemed to think that the Bursting Bubbles competition in the June/July issue of *Your Computer* was too easy. Luckily, our reputation was saved since all but two of those who complained had the wrong answer — perhaps they submitted the wrong answer as some obscure form of protest.

A more serious complaint by a few of the entrants was that it was easier to find the correct answer by pen and paper than by writing a laborious computer program. This may well have been the case, but a good many of you sent in the appropriate programs. We will make sure that the next competition is more difficult.

Of the 143 entries, a total of 64 produced the wrong answer and 79 were right. The wrong answers varied a great deal as did the programming techniques and skills displayed. Sadly, a number of you found the correct sequence of numbers and then proceeded to add them up to the wrong answer.

The correct sequence of numbers was $8 \times 6 + 4 \times 7 - 2 \times 5 + 3$ and $\times 1$ for good measure giving the correct answer of 1,813. The winner, picked out of the Competition Bag by Mandy Morley, was J W Ingram, 25 Glenside, Billericay, Essex, CM11 2LY. A £15 book token should have wound its way to his home by now.

There is no Competition Corner in this issue because of the Vic-20 crossword competition. We will return in the next issue with another puzzler. If you want to set and submit a puzzle, remember to design it so that the easiest way to find the proper answer should be to write a short computer program. Include with any suggested puzzle the answer and an explanation. We cannot reply to every letter or postcard sent in to Competition Corner.

How to submit an article

WE WILL consider any articles submitted for publication but they should not be more than 3,000 words long. Articles on any subject are welcome and they should, ideally, have something to do with personal computers.

Submissions should be typed with double spaces between lines and where programs are included, they should be computer-printed with a sample run of the program. We pay £35 per published page. Articles should be sent to *Your Computer*, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

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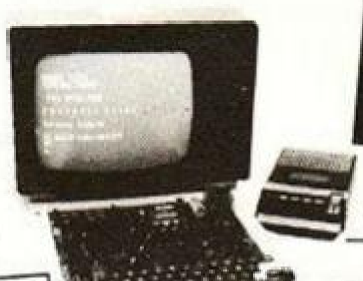
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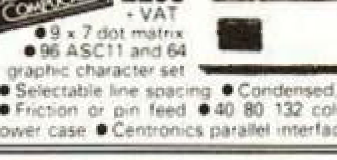
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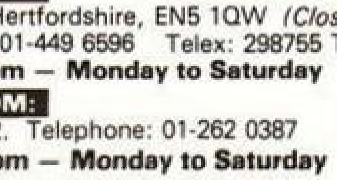
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